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PROGRAMS FOR COMPUTER SIMULATION OF HARDWOOD LOG SAWING.(U)
SEP 80 W K ADKINS, D B RICHARDS, D W LEWIS
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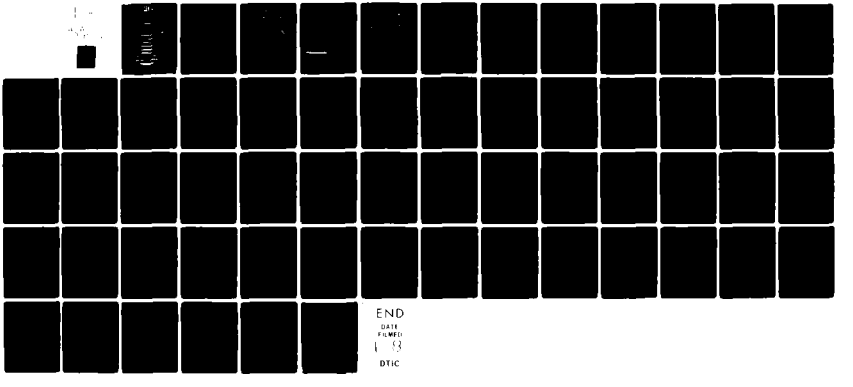

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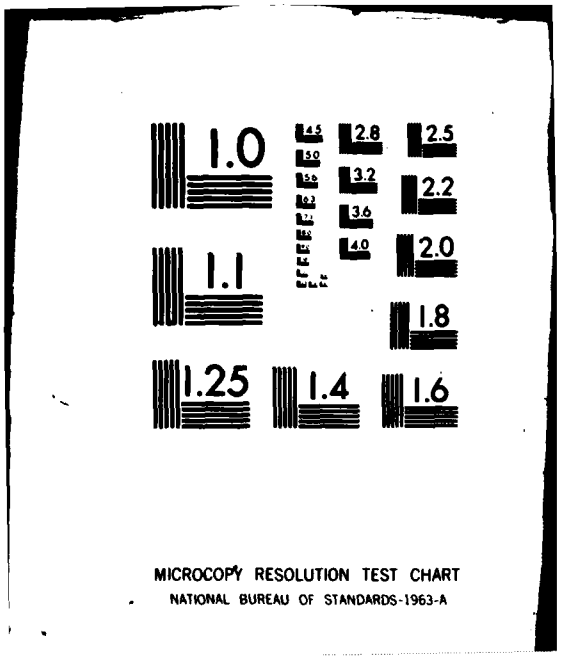
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**Forest
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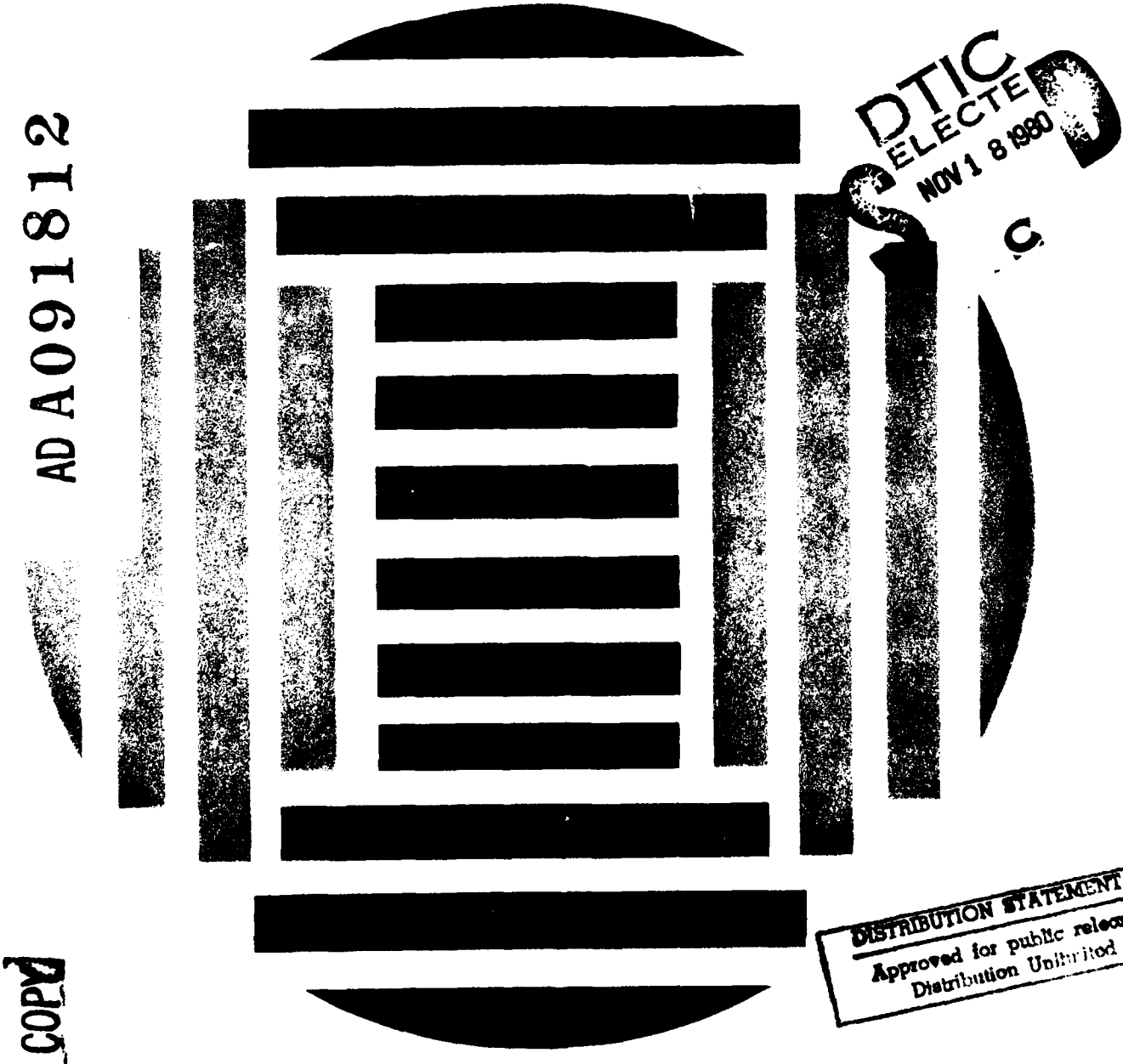
Research
Paper

FPL 357

September 1980

Programs for Computer Simulation of Hardwood Log Sawing



Preface

This Research Paper is one in a series of three which describe the computer simulation of hardwood log sawing. Mathematically modeled logs with a selection of tapers, diameters, core defect diameters, and knot patterns were sawn by four sawing methods, and the resultant values were recorded.

The first paper, USDA Forest Service Research Paper FPL 355, "Simulation of hardwood log sawing," describes the sawing methods, and the background and development of these programs.

The second paper, FPL 356, "Lumber values from computerized simulation of hardwood log sawing," presents the results of the sawing in terms of volume yield and lumber value, and compares them for the four sawing methods.

This third paper, FPL 357, "Programs for computer simulation of hardwood log sawing," lists the programs, model assumptions, and program organization and variables.

Abstract

Four computer programs were developed at the University of Kentucky as simulation models for investigating factors affecting sawn log value over four hardwood sawing methods: quadrant sawing, cant sawing, decision sawing, and live sawing with resaw for grade. The programs are listed, along with information on the sawing methods, model assumptions and program organization.

Keywords

Computer simulation

Mathematical modeling

Hardwood sawing

Computer programs

Quadrant sawing

Cant sawing

Live sawing

Decision sawing

Grade sawing

Grade yield

United States Department of Agriculture
Forest Service
Forest Products Laboratory[1]
Research Paper
FPL 357

Programs for Computer Simulation of Hardwood Log Sawing

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Introduction

Four computer programs were developed at the University of Kentucky as simulation models for investigating factors affecting sawn log value over four hardwood sawing methods: quadrant sawing, cant sawing, decision sawing, and live sawing with rerip for grade.

Information in this paper details the sawing methods, model assumptions, program organization, variables used, common storage areas, and program listings.

Sawing Methods

Cant and quadrant sawing are 4-sided sawing methods. Decision sawing is a possibly unbalanced 4-sided sawing method which responds to uncovered hidden defects by attempting to pick the log face which will yield the best lumber when the log face currently being cut drops in grade. Live sawing with rerip for grade is a 2-sided sawing method which attempts to increase board value by ripping out core defects.

Quadrant Sawing (QUAD)

The center cant in QUAD was arbitrarily picked to be a square cant that will yield four boards. Progressing outward from this central square cant, the boards increase in width in each quadrant in a stepwise fashion until the bark (i.e., log surface) is reached and then decrease appropriately to fit in the slab (fig. 1). In the program each quadrant is cut completely before progressing to another, but the board widths and the way they fit together at the corners are the same as would result if the log were turned about its axis after each board were cut, 180° turns alternating with 90° turns until the central square cant remains and is sawn into four boards.

Cant Sawing (CANT)

By cutting slabs and boards from faces 1 and 3 in CANT, a central cant is produced that has a selected thickness. This central cant is then turned 90° and sawn into boards kerf-centered from the log axis out (fig. 2). While in current studies the central cant was arbitrarily given a thickness of 2 inches less than half the log diameter [(D/2) - 2], it can, of course, be assigned any reasonable thickness.

Decision Sawing (DECID)

DECID simulates the decisions of a human sawyer in grade sawing. Faces 1, 2, 3, and 4 of the log are sawn in sequence until the log is square and wane-free at midlength. Each exposed face of the log is then graded by the Forest Products Laboratory (FPL) computerized grading program, the highest grade face is selected for sawing (surface area is used to decide ties), and the selected face is sawed until a grade drop occurs. The program again grades every affected face and selects the highest grade face for sawing (surface area decides ties) and continues sawing until a grade drop occurs. Log turning and sawing

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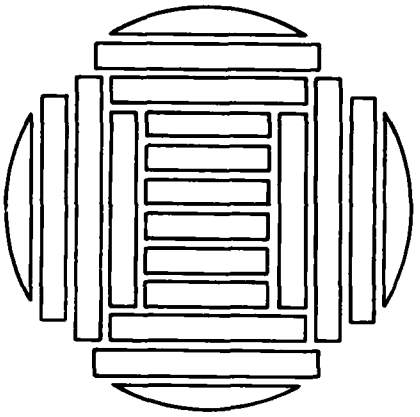

Figure 1.—End view of a quadrant sawn (QUAD) log.

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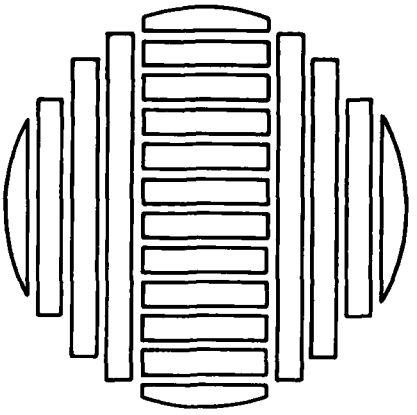

Figure 2.—End view of a cant sawn (CANT) log.

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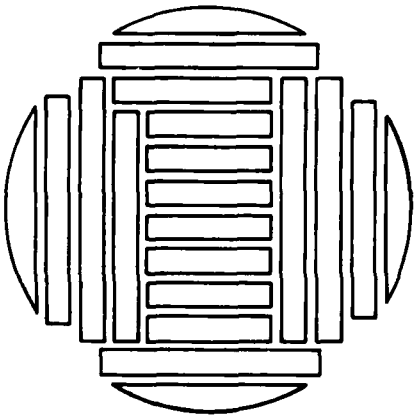

Figure 3.—End view of a decision sawn (DECID) log.

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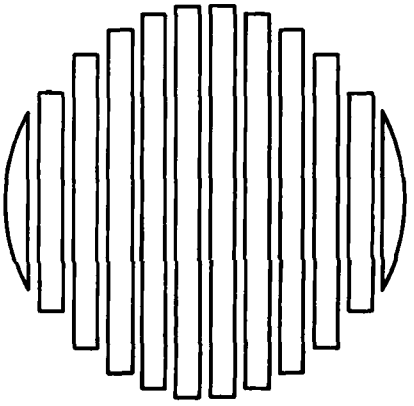

Figure 4.—End view of a live sawn (LIVE) log.

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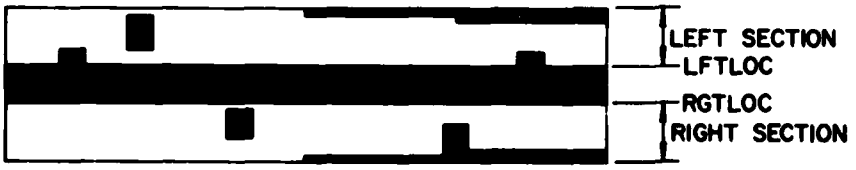

Figure 5.—Outer surface of a board that has been reripped for grade showing the coordinate system of the resulting three board sections as well as the truncation of any knots at the edge of a section.

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continues in like manner until a central square cant remains that will yield exactly four equal boards when parallel sawed. As noted earlier, some of the boards in DECID may be unsymmetrical with respect to the log axis (fig. 3).

Live Sawing with Reripping for Grade (LIVE)

A saw kerf bisects the log along the central axis in LIVE and the plane of each subsequent saw cut (and hence each board face) is parallel to this central cut (fig. 4).

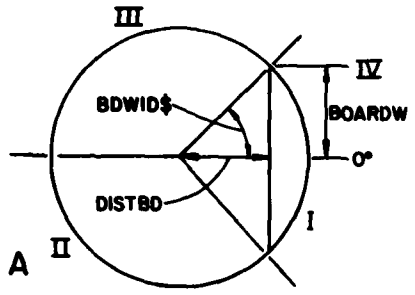
In the live rip method the log is sawed as in LIVE but the outer face of each board is then evaluated for defect type. If the central cylindrical core defect shows up on the outer face of the board, this defect is automatically ripped out and the boards produced are regraded and revalued (fig. 5). If the sum of the values of the boards so produced is higher than the value of the original wide board, the new rerip sum is substituted for the original wide board value. If the rerip value is less than the original wide board value, then the original value is retained and it is assumed that the board would not have been reripped. The rerip subroutine is applied in sequence to each board that has the central core defect appearing on the outer board face.

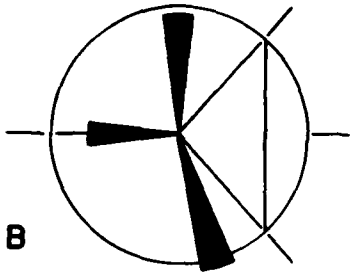
Model Assumptions

Log: A truncated cone with arbitrary length, small-end diameter, and taper. The length is measured in inches, the diameter in inches, and the taper in degrees.

Knot: A solid conic section of a sphere (i.e., a cone capped with the spherical surface) with arbitrary length, height in the log, and interior angle, emanating perpendicularly from the log axis. Length is measured in inches from the log axis, height in inches from the log base, and angle in degrees clockwise with zero degrees being the line from the log axis perpendicular to the initial saw face (figs. 6a-f).

Core Defect: A solid cylinder extending the full log length, which may or may not be centered on the log axis. Core diameter and linear offset from the log axis are measured in inches; angular offset





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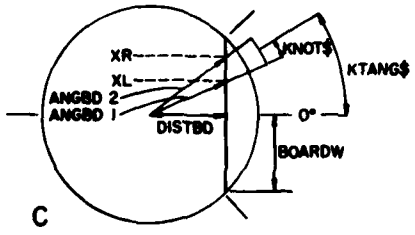

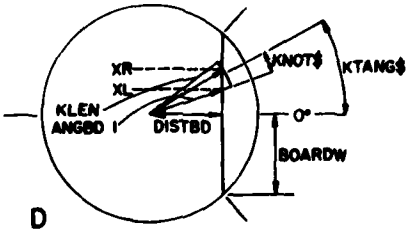

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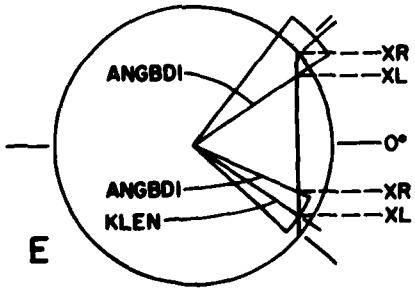

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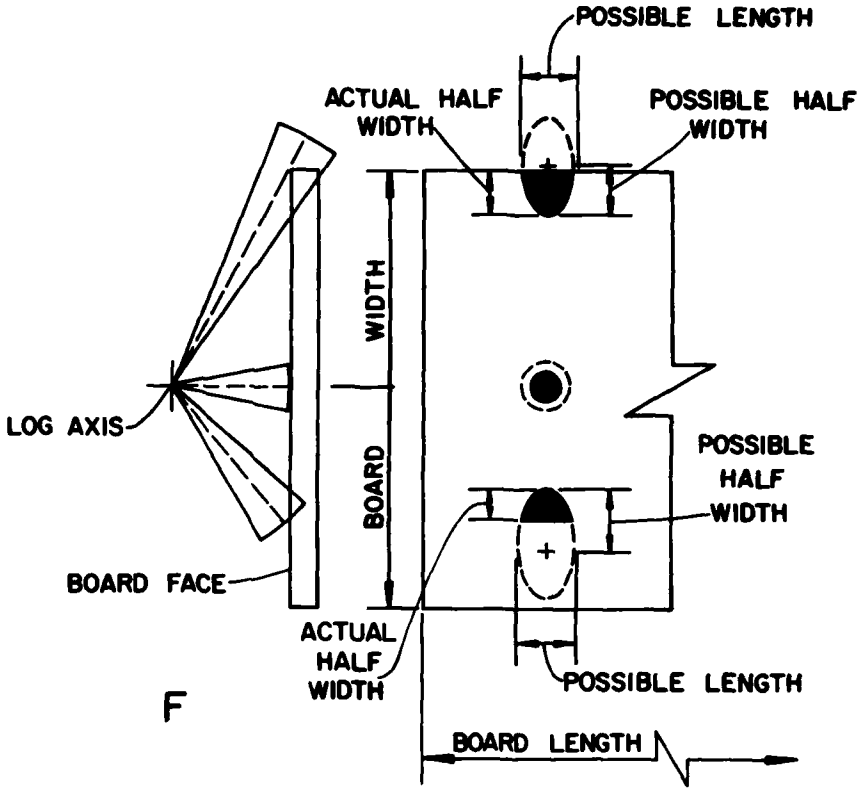

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Figure 6.—Method of evaluating knots which partially intersect a board face: (a) the sectors into which the log section is divided for evaluation of knot defect location on the board face; (b) knots that fall wholly in sectors II and III and hence do not intersect board face; (c) the modeling of a knot wholly in sector IV that fully penetrates the board face; (d) a knot that partially penetrates the board face due to the short length of the knot; (e) one knot that only partially penetrates the board face due to the fact that it is partially in sector III and another knot with partial penetration due to combination of short knot and angular position; (f) the pattern on the board of several knots that show partial penetration of various types.

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in degrees from the zero degree line defined above for knots (figs. 7, 8).

Edging Method: All boards are edged so that they are wane-free for at least one-half their length by assigning the width at midlength as the maximum board width (figs. 9, 10).

Defect Representation: All defects are measured in ¼-inch increments and placed on a board face as rectangles with dimensions of the maximum length and width of the actual defect (fig. 9).

Board: Rectangular with some width ≥ 3 inches at midlength; some width ≥ 2.5 inches at the top; some length ≥ 4 feet; and arbitrary thickness. In addition, the width of wane at any point along the board is limited to less than 4 inches. The board is cut back in length by 1-foot decrements until wane and width requirements are met. Length, width, and thickness are measured in inches. The length and width are converted to ¼-inch increments for board face grading (figs. 9, 10).

Wane: The first wane defect on a board edge begins at or near board midlength and extends to the minimum of either the board length or that point where the board halfwidth has decreased by ¼ inch. The next wane defect begins at the point the last one ended and extends to the next point of ¼-inch decrease; wane defects continue to be inserted in like manner until the end of the board is reached (figs. 9, 10).

Sawing: The log is sawed parallel to the log axis. Headsaw kerf and rerip saw kerf (live sawing with rerip only) are independently arbitrary and are measured in inches. The log is completely sawn for each of twelve 15° rotational increments of initial placement on the log carriage. The total log value and surface measure yield, as well as the surface measure in each of the permissible grades, is calculated for each rotational increment. High, low, and average values and yields are calculated for the 12 rotational positions.

Grading: Each board face with defects is graded by the FPL grading program. The final board grade is assigned based on the combination of grades of both faces. Possible grades are First

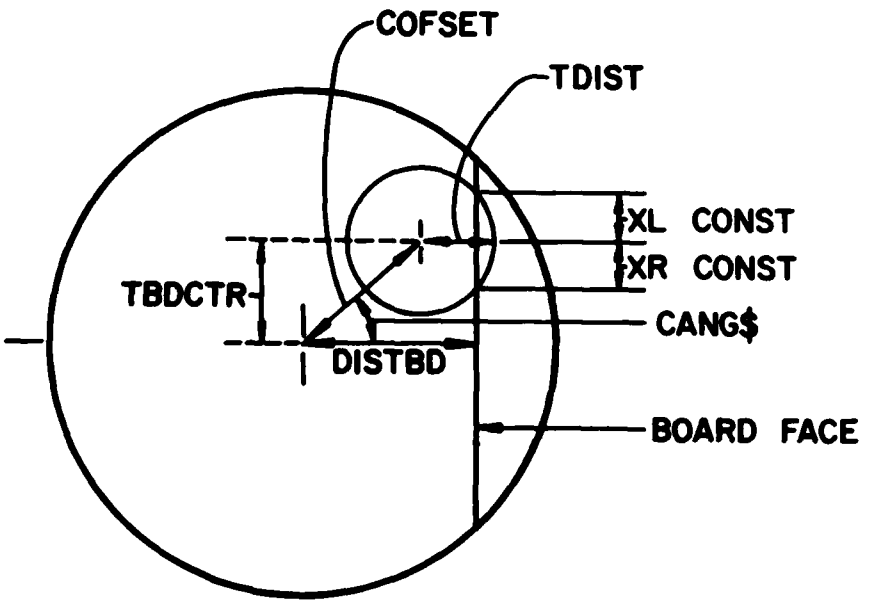

Figure 7.—A log section showing the core defect displaced from the central axis of the log.

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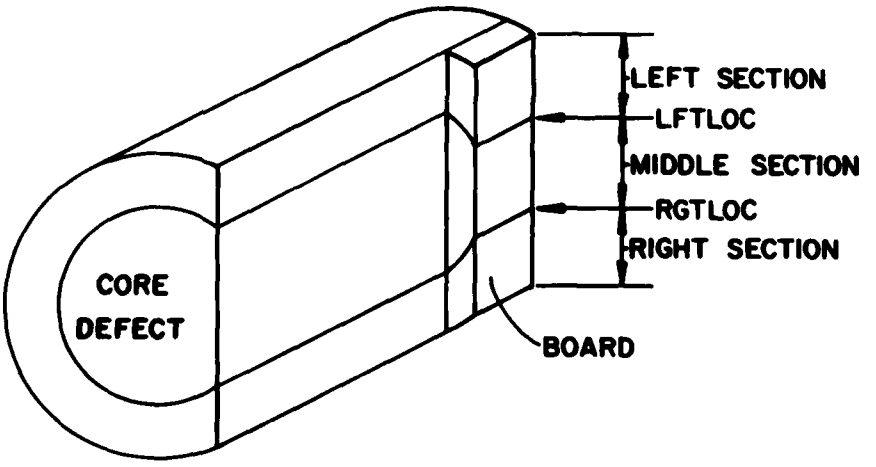

Figure 8.—Cross section of a log showing how the core defect is ripped out of a board if it appears on the outer face of a board. Although the ripping kerf is not shown, it is always taken out of the defective middle section.

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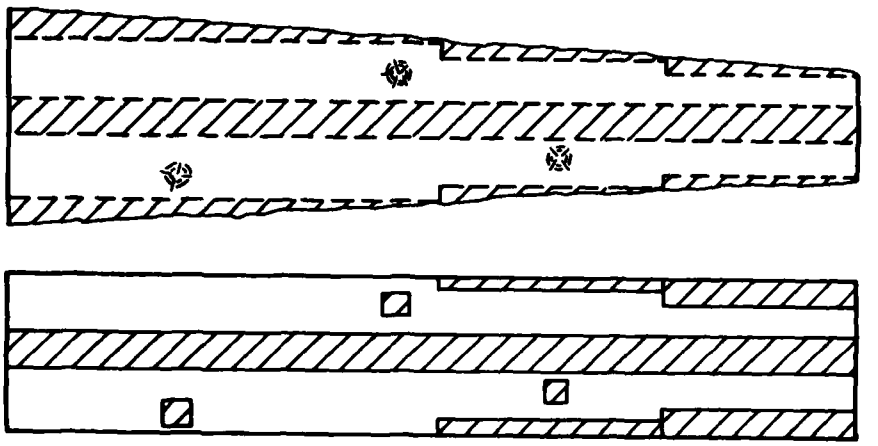

Figure 9.—The manner in which the computer would take the unedged board with knots (top view) and model it as an edged board with rectangular wane, knot, and core defects (bottom view).

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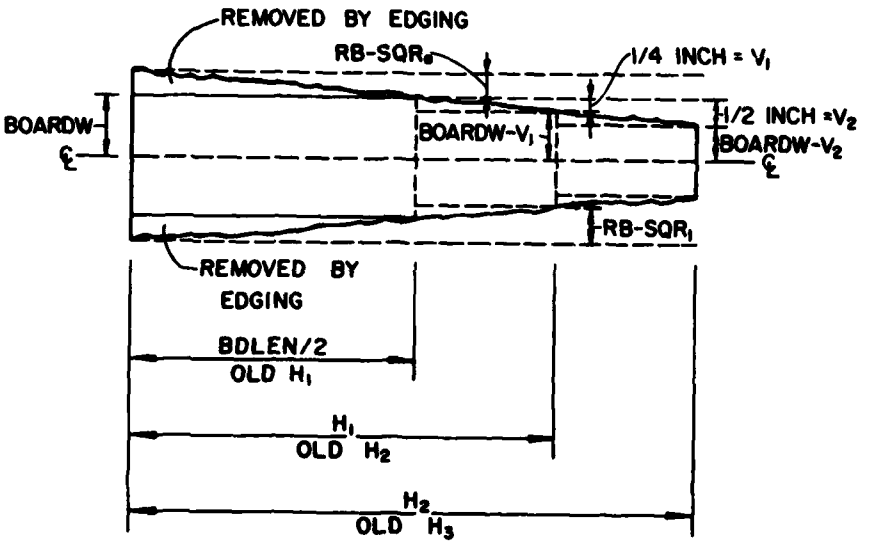

Figure 10.—The outer face of a waney board showing how subroutine WANE edges the board and puts in the wane defects.

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Table 1.—Board grade assigned by PRICE based on the grade of each board face returned from subroutine GRADE

Grade of *second* board face	Grade of one board face				
	FAS	Select	1C	2C	Below 2C
FAS	FAS	—	FAS1F[1]	2C	Below 2C
Select	—	1C	1C	2C	Below 2C
1C	FAS1F	1C	1C	2C	Below 2C
2C	2C	2C	2C	2C	Below 2C
Below 2C	Below 2C	Below 2C	Below 2C	Below 2C	Below 2C

[1] The NHLA Hardwood Standard Grades allow the option of grading using either the grade of "Selects" or "FAS1F." The FPL grading program was designed to use the "Selects" grade. This *sawing simulation program uses the* "FAS1F" grade which is determined as shown above.

and Seconds (FAS), either FAS One Face or Selects, One Common (IC), Two Common (2C), and combined 3A/3B. The value of lumber in each grade is user supplied and is measured in dollars per square foot surface measure. The current version of the grading program allows 22 defects per board face. Faces with defects exceeding this are arbitrarily assigned a grade of 3A/3B and a message printed.

Program Organization

Input, initialization, program control, and printing of results are performed in the main program. Cutting a board from the log and the mathematical description of the resulting board is performed by subroutine KERF. Wane defects are located by subroutine WANE (fig. 10). Knot defects are located by subroutine KNOT (figs. 6a-f). Core defects are located by subroutine CORE (fig. 7). Board value is determined by subroutine PRICE (table 1). Best log face determination in decision sawing is performed by subroutine DECIDE. Rerip for grade in live sawing is performed by subroutine RERIP, which prepares and updates rerip parameters (fig. 8), and RIP, which prepares the grading linkages for each rerip piece (fig. 5). Linkage to the grading subroutine is performed by subroutine GRADE. Subroutine GRADE is the FPL grading program converted for use on an IBM 370/165. For a description, refer to USDA Forest Service Research Paper FPL 157, "Grading Hardwood Lumber by Computer," and "Computer Program for Grading Hardwood Lumber," by Lynn Galiger and Hiram Hallock, both available from the Forest Products Laboratory, Madison, Wis.

Program Variables

The variables appear in all programs unless otherwise noted.

PROGRAM LEGEND: C (CANT), Q (QUAD), L (LIVE), D (DECID).

A:	argument to functions DEG and RAD (degrees or radians)
ANGBD1:	distance from log axis to board face along the knot edge nearest the board face (in.) (figs. 6c-e)
ANGBD2:	distance from log axis to board face along the knot edge farthest from the board face (in.) (fig. 6c)
ANGLE:	array containing knot horizontal angles within the log (degrees) (user supplied)
AVG$	average log value obtained over the 12 rotational positions on the carriage ($)
AVRIP (L):	average percent of available log surface measure realized under rerip over the 12 rotational positions on the carriage
AVRIP$ (L):	average log value obtained under rerip over the 12 rotational positions on the carriage ($)
AVTOTS (D):	average percent of available log surface measure realized over the 12 rotational positions
BDLEN:	current board length (in.) (fig. 10)
BDWID$:	current board angular halfwidth at board midlength measured from a line from the log axis perpendicular to the board face (degrees) (fig. 6a)
BF:	board surface measure of the current board
BOARDW:	current board halfwidth measured at board midlength (in.) (figs. 6a, 6c, 6d, 10)
CANG$:	core defect angular offset measured from a line perpendicular to the board face (degrees) (user supplied) (fig. 7)
CANT (C):	cant size (in.)
CMPLET (D):	array which indicates which log faces are completely cut
COFSET:	core defect linear offset from log axis (in.) (user supplied) (fig. 7)
CONST:	core defect halfwidth on current board face (in.) (fig. 7)
CON1:	calculation constant
CON2:	calculation constant
CORDIA:	core defect diameter (in.) (user supplied)
CORFLG (L):	a flag which indicates whether or not a core defect was found on the current board outer face
CQUENS (D):	array which records the sequence of log face cutting
CRADUS:	core defect radius (in.)
D:	log small-end diameter (in.) (user supplied)
DAT:	contains the current date returned by the DATE function (character string)
DEG:	result of conversion to degrees of an argument supplied in radians (degrees)
DISTBD:	distance from log axis to current board face (in.) (figs. 6a, 6c, 6d, 7)
DSTLFT (D):	distance from log axis to the log face counterclockwise from the current face (in.)
DSTRGT (D):	distance from log axis to the log face clockwise from the current face (in.)
DUMYRP (L):	array which contains the surface measures of the reripped board sections (fbm)
DY:	current knot defect halflength along the length of the current board
EXCESS (D):	discarded slab portion on each face which is outside the first saw cut (in.)
F:	face of the log which is currently being cut
FAS:	value per board foot of FIRST and SECONDS ($) (user supplied)
FLFT (D):	log face counterclockwise from the current log face
FLX:	array which contains all defect lower X-coordinates on the current board face (¼-in. units)
FLY:	array which contains all defect lower Y-coordinates on the current board face (¼-in. units)
FRT (D):	log face clockwise from the current log face
FULWID:	calculated halfwidth of the current knot defect on the board face if a full intersection were to occur
FUX:	array which contains all defect upper X-coordinates on the current board face (¼-in. units)

FUY:	array which contains all defect upper Y-coordinates on the current board face (¼-in. units)
GDBEST (D):	grade of the current best log face
GDORDR (D):	array which records the board grades in the sequence they are cut from the log
GRDCOM (D):	array which contains the current log face grades
GRDLFT (L):	grade of left rerip section of the outer face of the current board
GRDMID (L):	grade of center rerip section of the outer face of the current board
GRDRGT (L):	grade of right rerip section of the outer face of the current board
H:	height of the end of the current wane defect on the current board face (¼-in. units) (fig. 10)
HEIGHT:	array which holds the height of the knots measured from log base (in.) (user supplied)
HIGH$:	highest log value obtained over the 12 rotational positions on the carriage ($)
HIRIP (L):	percent of available log surface measure realized by reripping at the position on carriage which resulted in the highest log value while reripping (%)
HIRIP$ (L):	highest log value obtained from reripping over the 12 rotational positions on the carriage ($)
HITOT (D):	percent of available log surface measure realized at the position on the carriage which resulted in the highest log value (%)
I:	loop counter which indicates face of the current board under consideration
ID:	array which records types of defects on the current board face
II (D):	loop counter used while regrading affected log faces
IMGRD (L):	grade of center rerip section of the outer face of the current board
INDEX (L):	index of the core defect in the defect array
INX:	counter for the 12 rotational increments of the log position on the carriage
IOLDLT (L):	grade of left rerip section of the outer face of the current board
IOLDRT (L):	grade of right rerip section of the outer face of the current board
IREGRD (D):	flag which indicates whether a log face is being regraded
IROTAT:	current log position on the carriage for the 12 rotational increments (degrees)
ISQUAR (D):	flag which indicates whether the log has been squared at midlength
ITYPE (L):	array which saves defect types in the current board during rerip
IX:	array used for passing defect type to FPL grading program
J:	general do-loop counter
JCMPLT (D):	counts log faces which are completely cut
JJ (D):	do-loop counter
K:	kerf size (in.) (user supplied)
KHIGH:	height in the log of the current knot (in.)
KLEN:	length of the current knot (in.) (figs. 6d, 6e)
KNOT$:	knot half-angle (degrees) (user supplied) (figs. 6c, 6d)
KTANG$:	angle of the current knot with respect to a line perpendicular to the current board face (degrees) (figs. 6c, 6d)
KTLEN:	array which contains the knot lengths (in.) (user supplied)
L:	log length (in.) (user supplied)
LFTLOC (L):	current board left rerip location (¼-in.) (figs. 5, 8)
LGRADE (L):	grade of the current board face left rerip section
LOG$:	half-angle of log taper (degrees) (user supplied)
LORIP (L):	percent of available log surface measure realized by reripping at the rotational position on the carriage which yielded the least log value while reripping
LRADUS:	log radius at the height of the current knot (in.)
LVOL:	total available log surface measure (ft^3)
LX (L):	array which saves defect lower X-coordinates in the current board during rerip
LY (L):	array which saves defect lower Y-coordinates in the current board during rerip
M:	current number of defects found in the current board
MAX:	number of knots in the log (user supplied)
N (L):	current number of defects found in the current rerip section

Program Variables (Cont.)

NBD:	board counter
NBRDS (D):	number of boards which could ideally be cut from each log face
NODEFC:	array which contains the current number of defects found in the current board face
NPG:	grade of the current board face
OLD:	grade of the outer face of the current board
OLDH:	beginning height of the current wane defect (¼-in. units) (fig. 10)
OLDVAL (L):	value of the current board before rerip ($)
ONEC:	dollar value per board foot of *1* Common lumber ($) (user supplied)
PERC:	total surface measure in each grade realized at the current rotational position on the carriage (ft^2)
PERCRP (L):	total surface measure in each grade realized by reripping at the current rotational position on the carriage (ft^2)
POSLEN:	board length of those boards which may be shorter than log length due to log taper (in.)
R:	that position of the log face remaining to be cut (in.)
RB:	log radius at the base (in.) (fig. 10)
RCUT (D):	array which contains the portion of each log face which has been cut (in.)
RGRADE (L):	grade of the current right rerip section
RGTLOC (L):	current board right rerip location (¼-in. units) (figs. 5, 8)
RI:	log top end radius (in.)
RM:	log radius at the height of the middle of the current board (in.)
RPKERF (L):	rerip kerf size (in.) (user supplied)
RPLOSS (L):	current surface measure loss due to rerip (ft^2)
RPTOTS (L):	total surface measure realized by reripping at the current rotational position on the carriage (ft^2)
RT:	log radius at the top of the current board (in.)
RTBCUT (D):	the portion of each log face which may be cut (in.)
SEL:	dollar value per board foot of Selects lumber ($) (user supplied)
SM:	rounded surface measure (ft^2)
SMALL$:	smallest log value obtained during the 12 rotational positions on the carriage ($)
SMBEST (D):	surface measure of the current best log face (ft^2)
SMF (D):	array which contains the current surface measure of each log face
SMLFT (L):	surface measure of the current left rerip section (ft^2)
SMMID (L):	surface measure of the current center rerip section (ft^2)
SMRGT (L):	surface measure of the current right rerip section (ft^2)
SMRIP$ (L):	smallest log value obtained by reripping at any one of the 12 rotational positions on the carriage ($)
SMTOT (D):	total surface measure realized in the current rotational position (ft^2)
SQR:	calculation constant (fig. 10)
T:	board thickness (in.) (user supplied)
TBDCTR:	distance on the current board face from board midwidth to the center point of the intersection of the board face and the core defect (in.) (fig. 7)
TCANG$ (D):	core angular offset adjusted to reflect the face of the log currently being cut (degrees)
TDIST:	perpendicular distance from the center of the core defect to the current board face (in.) (fig. 7)
THRB:	dollar value per board foot for combined 3A/3B lumber ($) (user supplied)
TLOSS (L):	rerip surface measure loss in the current board due to a rerip section falling below 3 inches in width (ft^2)
TOTS:	used for surface measure and percent surface measure conversions
TVAL:	total log value obtained at the current rotational position on the carriage ($)
TVALRP (L):	total log value obtained by reripping at the current rotational position on the carriage ($)

TWOC:	dollar value per board foot for 2 Common lumber ($) (user supplied)
UX (L):	array which saves defect upper X-coordinates of the current board face during rerip
UY (L):	array which saves defect upper Y-coordinates of the current board face during rerip
V:	current board value ($)
WAN:	total wane on the current board face from board mid-length to board end, subroutine WANE only (¼-in. units) (fig. 10)
WIDLFT (L):	width of the current left rerip section (in.)
WIDMID (L):	width of the current center rerip section (in.)
WIDRGT (L):	width of the current right rerip section (in.)
WIDTH (L):	saves current board width during rerip (¼-in. units)
WMB (Q):	current board halfwidth at board midlength when the log has been squared (in.)
WT:	current board halfwidth at the top of the board (in.)
XL:	current defect lower X-coordinate on the current board face (¼-in. units) (fig. 6d, 6e, 7)
XR:	current defect upper X-coordinate on the current board face (¼-in. units) (fig. 6d, 6e, 7)
YB:	current defect lower Y-coordinate on the current board face (¼-in. units)
YT:	current defect upper Y-coordinate on the current board face (¼-in. units)

Common Storage Areas

BOARD:	contains information pertaining to the log and boards cut from the log
DECID (Decision sawing only):	contains information necessary in the determination of the log face which should yield the best board
DEFEC:	contains information of all defects on the current board face
FORRIP (Live sawing only):	contains information used in rerip for grade
PRICE:	contains pricing information for lumber in each grade

Quadrant Sawing (QUAD)


```
C   'QUAD' IS A BALANCED METHOD OF SAWING AROUND A CENTRAL SQUARE CANT
C   CONTAINING EXACTLY FOUR BOARDS.  THE PROGRAM CUTS FROM THE CENTRAL
C   CANT OUTWARD AND COMPLETES ONE QUADRANT BEFORE PROGRESSING TO
C   ANOTHER
C
C
      IMPLICIT REAL (K,L)
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),PERC(5),ANGLE(40),
     .     HEIGHT(40),KTLEN(40),DAT*8
      INTEGER ID(22,2),NODEFC(2),OLD,F
      COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
     .      /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,BF
     .      /PRICE/ FAS,SEL,ONEC,TWOC,THRB
C
C
C   THIS PROGRAM ASSUMES INPUT FROM UNIT 5 AND OUTPUTS TO UNITS 6 AND 8
C
C   GET LOG DIAMETER (IN.), LOG LENGTH (IN.), KERF SIZE (IN.), AND
C   BOARD THICKNESS (IN.)
C
    1 READ (5,100,END=17) D
      READ (5,100) L
      READ (5,101) K
      READ (5,100) T
C
C   GET KNOT HALF-ANGLE (DEGREES) AND LOG HALF-TAPER (DEGREES)
C
      READ (5,100) KNOT$
      READ (5,100) LOG$
C
C   GET CORE DEFECT PARAMETERS: DIAMETER (IN.), LINEAR OFFSET (IN.),
C   AND ANGULAR OFFSET (DEGREES)
C
      READ (5,116) CORDIA
      READ (5,116) COFSET
      READ (5,116) CANG$
C
C   GET PRICE PER BOARD FOOT FOR EACH GRADE: NUMBER OF KNOTS
C
      READ (5,103) FAS,SEL,ONEC,TWOC,THRB
      READ (5,119) MAX
C
C   GET DATE AND CALCULATE RADIUS OF CORE DEFECT
C
      CALL DATE (DAT)
      CRADUS = CORDIA/2.
C
C   GET KNOT ANGLES, HEIGHTS, AND LENGTHS
C
      DO 2 J=1,MAX
        READ (5,117) ANGLE(J),HEIGHT(J)
    2 CONTINUE
      DO 3 J=1,MAX
        READ (5,116) KTLEN(J)
    3 CONTINUE
C
C   CALCULATE LOG RADIUS AT TOP AND BOTTOM; TOTAL LOG CUBIC FEET
C
      RI = D/2.
      RB = RI+L*TAN(RAD(LOG$))
      LVOL = 1/3.*3.141593*(RB**2+RB*RI+RI**2)*L/144.
C
C   OUTPUT HEADER
C
      WRITE (6,104) DAT
      WRITE (6,105) L,D,LOG$,LVOL
      WRITE (6,119) MAX
      DO 4 J=1,MAX
        WRITE (6,115) ANGLE(J),HEIGHT(J),KTLEN(J)
    4 CONTINUE
      WRITE (6,106) KNOT$
      WRITE (6,102) CRADUS,COFSET,CANG$
      WRITE (6,107) K,T
      WRITE (6,108) FAS,SEL,ONEC,TWOC,THRB
      WRITE (8,200) L,D,MAX,CRADUS,COFSET,CANG$,LVOL,K,T,KNOT$,LOG$
      WRITE (8,201) (KTLEN(J),J=1,MAX)
      WRITE (8,201) (HEIGHT(J),J=1,MAX)
      WRITE (8,201) (ANGLE(J),J=1,MAX)
      WRITE (8,202) FAS,SEL,ONEC,TWOC,THRB
C
C   INITIALIZE VARIABLES FOR CALCULATING HIGH, LOW, AND AVERAGE
C   YIELDS FOR EACH LOG
C
      HIGH$ = 0.
      SMALL$ = 999.
      AVG$ = 0.
C
C
C   SAW LOG IN 12 DIFFERENT ROTATIONAL POSITIONS, 15 DEGREES APART, TO
C   DETERMINE THE ORIENTATION GIVING THE HIGHEST YIELD
C
      DO 16 INX=1,12
C
C   INITIALIZE FOR EACH POSITION
C
        BF = 0.0
        TVAL = 0.0
        NBD = 0
        DO 5 J=1,5
          PERC(J) = 0.0
    5   CONTINUE
C
C   FOR FOUR SIDES OF THE LOG...
C
        DO 13 F=1,4
C
C   INITIALIZE PORTION OF LOG TO BE CUT... THIS SETS THE DEPTH OF THE
C   FIRST CUT.  THE SLAB FACES ARE CUT TO A FOUR BOARD CANT
C
          IF (F.EQ.1.OR.F.EQ.3) R = RB-2.*T-1.5*K
C
C   THE CANT FACES ARE KERF CENTERED TO DIVIDE THE CANT
C
          IF (F.EQ.2.OR.F.EQ.4) R = RB+K/2.
C
C   CUT BOARDS FROM THIS FACE UNTIL FACE IS COMPLETELY CUT.  THE LOG IS
C   CUT FROM THE INSIDE OUT
C
    6     CALL KERFQ (&11,NBD,F)
C
C   FOR BOTH SIDES OF THE BOARD...
C
          DO 10 I=1,2
C
C   INITIALIZE DEFECT ARRAYS, EXCEPT F..(26,1), WHICH HOLDS THE BOARD
C   DIMENSIONS
C
            DO 7 J=1,25
              FLX(J,I) = -9999.0
              FUX(J,I) = -9999.0
              FLY(J,I) = -9999.0
              FUY(J,I) = -9999.0
    7       CONTINUE
            DO 8 J=1,22
              ID(J,I) = 0
    8       CONTINUE
            NODEFC(I) = 0
C
C   PUT IN WANE DEFECTS
C
            CALL WANEQ
C
C   PUT IN KNOTS
C
```

```
145              DO 9 J=1,MAX                                                  QUAD
146                CALL KNOTO (HEIGHT(J),KTLEN(J),ANGLE(J))                    QUAD
147        9     CONTINUE                                                      QUAD
148 C                                                                          QUAD
149 C    PUT IN CORE DEFECT                                                    QUAD
150 C                                                                          QUAD
151              CALL COPEO (CRADUS,COFSET,CANG$)                              QUAD
152 C                                                                          QUAD
153 C    AND GRADE THE FACE                                                    QUAD
154 C                                                                          QUAD
155              CALL GRADE (NPG)                                              QUAD
156 C                                                                          QUAD
157 C    SAVE GRADE OF FIRST SIDE OF BOARD                                     QUAD
158 C                                                                          QUAD
159              IF (I.EQ.1) OLD = NPG                                         QUAD
160 C                                                                          QUAD
161 C    SUBTRACT BOARD THICKNESS AND PROCESS THE INNER FACE                   QUAD
162 C                                                                          QUAD
163              DISTBD = DISTBD-T                                             QUAD
164      10    CONTINUE                                                       QUAD
165 C                                                                          QUAD
166 C    DETERMINE BOARD GRADE AND VALUE BASED ON GRADES OF BOTH FACES         QUAD
167 C                                                                          QUAD
168           CALL PRICEO (OLD,NPG,TVAL,PERC)                                  QUAD
169 C                                                                          QUAD
170 C    CUT ANOTHER BOARD                                                     QUAD
171 C                                                                          QUAD
172           GO TO 6                                                          QUAD
173 C                                                                          QUAD
174 C    TURN LOG 90 DEGREES TO CUT NEXT FACE                                  QUAD
175 C                                                                          QUAD
176      11    DO 12 J=1,MAX                                                  QUAD
177              ANGLE(J) = AMOD(ANGLE(J)+090.0,360.0)                         QUAD
178      12    CONTINUE                                                       QUAD
179            CANG$ = AMOD(CANG$+90.0,360.0)                                 QUAD
180            NBD = 0                                                        QUAD
181      13    CONTINUE                                                       QUAD
182 C                                                                          QUAD
183 C    PRINT RESULTS FOR THIS POSITION                                       QUAD
184 C                                                                          QUAD
185          IROTAT = INX*15-15                                                QUAD
186          WRITE (6,114) IROTAT                                              QUAD
187          WRITE (6,113) (PERC(J),J=1,5)                                     QUAD
188          TOTS = PERC(1)+PERC(2)+PERC(3)+PERC(4)+PERC(5)                    QUAD
189          WRITE (6,112) TOTS                                                QUAD
190          WRITE (8,203) IROTAT                                              QUAD
191          WRITE (8,204) (PERC(J),J=1,5                                      QUAD
192          WRITE (8,204) TOTS                                                QUAD
193          DO 14 J=1,5                                                       QUAD
194            PERC(J) = (PERC(J)/LVOL)*100.                                   QUAD
195      14    CONTINUE                                                       QUAD
196          TOTS = (TOTS/LVOL)*100.                                           QUAD
197          WRITE (6,111) TOTS                                                QUAD
198          WRITE (6,110) (ANGLE(J),J=1,MAX)                                  QUAD
199          WRITE (6,120) (PERC(J),J=1,5),TVAL                                QUAD
200          WRITE (8,205) (PERC(J),J=1,5)                                     QUAD
201          WRITE (8,204) TVAL,TOTS                                           QUAD
202 C                                                                          QUAD
203 C    SAVE HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG                       QUAD
204 C                                                                          QUAD
205          AVG$ = AVG$+TVAL                                                  QUAD
206          IF (TVAL.GT.HIGH$) HIGH$ = TVAL                                   QUAD
207          IF (TVAL.LT.SMALL$) SMALL$ = TVAL                                 QUAD
208 C                                                                          QUAD
209 C    ROTATE LOG BY 15 DEGREES AND REPROCESS                                QUAD
210 C                                                                          QUAD
211          DO 15 J=1,MAX                                                     QUAD
212            ANGLE(J) = AMOD(ANGLE(J)+15.0,360.0)                            QUAD
213      15    CONTINUE                                                       QUAD
214          CANG$ = AMOD(CANG$+15.0,360.0)                                    QUAD
215      16 CONTINUE                                                         QUAD
216 C                                                                          QUAD
217 C                                                                          QUAD
218 C    PRINT HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG                      QUAD
219 C                                                                          QUAD
220        AVG$ = AVG$/12.                                                     QUAD
221        WRITE(6,103) HIGH$,AVG$,SMALL$                                      QUAD
222 C                                                                          QUAD
223 C    LOG COMPLETELY PROCESSED. READ PARAMETERS FOR NEXT LOG                QUAD
224 C                                                                          QUAD
225          GO TO 1                                                           QUAD
226 C                                                                          QUAD
227      17 STOP                                                             QUAD
228 C                                                                          QUAD
229 C    FORMATS FOR DEVICE 6 (PRINTER)                                        QUAD
230 C                                                                          QUAD
231    100 FORMAT (F5.1)                                                       QUAD
232    101 FORMAT (F5.3)                                                       QUAD
233    102 FORMAT (' CORE DEFECT RADIUS ',F7.2,'LINEAR OFFSET ',F7.2,          QUAD
234       .  'ANGULAR OFFSET ',F7.2)                                           QUAD
235    103 FORMAT (' $ YIELD: HIGH ',F6.2,'  AVERAGE ',F6.2,'  LOW ',F6.2)     QUAD
236    104 FORMAT (' QUADRANT SAWING METHOD ',A8)                              QUAD
237    105 FORMAT (' LOG PARAMETERS:  LENGTH',F6.1,'  DIA',F6.1,'  TAPER',     QUAD
238       .  F6.4,' DEGREES.  LOG VOLUME:',F8.2,' CUBIC FEET')                 QUAD
239    106 FORMAT (' ANGLES MEASURED FROM ZERO DEGREES = EAST FOR A ',         QUAD
240       .  'VERTICALLY CUTTING SAW.  KNOT TAPER',F6.2)                       QUAD
241    107 FORMAT (' CUTTING PARAMETERS:  KERF',F6.4,'  BOARD THICKNESS',      QUAD
242       .  F5.2)                                                             QUAD
243    108 FORMAT (' PRICES PER BOARD FOOT: ',5F10.4)                          QUAD
244    109 FORMAT (5F10.4)                                                     QUAD
245    110 FORMAT (' KNOT ANGLES: ',15F7.2,2(/,13X,15F7.2))                   QUAD
246    111 FORMAT (' TOTAL PERCENT YIELD IS ',F5.2)                            QUAD
247    112 FORMAT (' TOTAL SURFACE MEASURE IS',F8.2)                           QUAD
248    113 FORMAT (' SURFACE MEASURE PER GRADE IS ',5F7.2)                     QUAD
249    114 FORMAT (2(/),'  ROTATION IS ',I4)                                   QUAD
250    115 FORMAT (3F7.2)                                                      QUAD
251    116 FORMAT (F6.3)                                                       QUAD
252    117 FORMAT (2F6.2)                                                      QUAD
253    118 FORMAT (I2)                                                         QUAD
254    119 FORMAT ('1THERE ARE',I3,' KNOTS IN THIS LOG. THEY ARE'              QUAD
255       .  1X,'ANGLE  HEIGHT  LENGTH')                                       QUAD
256    120 FORMAT (' % AVAILABLE SURFACE MEASURE IN EACH GRADE ',5F5.1,         QUAD
257       .    LOG VALUE IS $',F6.2)                                          QUAD
258 C                                                                          QUAD
259 C    FORMATS FOR DEVICE 8 (STORAGE MEDIUM)                                 QUAD
260 C                                                                          QUAD
261    200 FORMAT (F6.1,F5.1,I3,3F5.1,F8.2,F6.3,F4.1,F6.2,F5.3,F6.3)           QUAD
262    201 FORMAT (3(10F7.2/))                                                 QUAD
263    202 FORMAT (5F7.4)                                                      QUAD
264    203 FORMAT (I3)                                                         QUAD
265    204 FORMAT (5F8.2)                                                      QUAD
266    205 FORMAT (10F6.2)                                                     QUAD
267        END                                                                 QUAD
```

*** STATEMENT NUMBERS ***

1	*21	225
2	50	*52
3	53	*55
4	68	*70
5	99	*101
6	*119	172
7	128	*133
8	134	*136
9	145	*147
10	123	*164
11	119	*176
12	176	*178
13	105	*181
14	193	*195
15	211	*213
16	92	*215
17	21	*227

* indicates line at which symbol or number is defined

*** VARIABLES ***

Subroutine KERF

```
C   SUBROUTINE 'KERF' CUTS A BOARD FROM THE LOG.  THE BOARD WIDTH IS    KERFO
C   DEFINED AT THE CENTER, AND THE BOARD LENGTH FROM THE BOTTOM         KERFO
C   OF THE LOG                                                          KERFO
C                                                                       KERFO
C                                                                       KERFO
      SUBROUTINE KERFQ (*,NBD,F)                                        KERFO
C                                                                       KERFO
      IMPLICIT REAL (K,L)                                               KERFO
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                      KERFO
      INTEGER ID(22,2),NODEFC(2),F                                      KERFO
      COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                          KERFO
     +      /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,BF      KERFO
C                                                                       KERFO
C                                                                       KERFO
C   ALL BOARDS MUST BE AT LEAST 48 INCHES LONG, 2.5 INCHES WIDE AT      KERFO
C   THE TOP, AND 3 INCHES WIDE AT THE CENTER.  IN ADDITION, THE TOTAL   KERFO
C   AMOUNT OF WANE FROM THE CENTER TO THE TOP IS LIMITED TO 4 INCHES.   KERFO
C   THE BOARD IS CUT BACK IN ONE FOOT INCREMENTS IF THE WIDTH OR WANE   KERFO
C   TESTS FAIL.  IF THE LENGTH TEST FAILS, ANOTHER BOARD IS CUT FROM    KERFO
C   THIS FACE                                                           KERFO
C                                                                       KERFO
C   FIND OUTER FACE OF BOARD                                            KERFO
C                                                                       KERFO
      RI = D/2.                                                         KERFO
    1 R = R-T-K                                                         KERFO
      NBD = NBD+1                                                       KERFO
      BDLEN = L                                                         KERFO
C                                                                       KERFO
C   IF THIS FACE OF THE LOG IS COMPLETELY CUT, EXIT                     KERFO
C                                                                       KERFO
      IF (R.LT.0.) RETURN1                                              KERFO
      DISTBD = RB-R                                                     KERFO
      WMB = DISTBD-T-K                                                  KERFO
      IF (F.EQ.1.OR.F.EQ.3) WMB = DISTBD                                KERFO
C                                                                       KERFO
C   THE CENTRAL CANT HAS BEEN DEFINED AS FOUR BOARDS SQUARE             KERFO
C                                                                       KERFO
      IF (NBD.LT.3.AND.(F.EQ.2.OR.F.EQ.4)) WMB = 2.*T+1.5*K             KERFO
      POSLEN = R*TAN(RAD(90.-LOG$))                                     KERFO
C                                                                       KERFO
C   CHECK FOR BOARDS SHORTER THAN THE LOG DUE TO LOG TAPER              KERFO
C                                                                       KERFO
      IF (POSLEN.LT.BDLEN) BDLEN = POSLEN                               KERFO
C                                                                       KERFO
C   BOARDS MUST BE AT LEAST 4 FEET LONG                                 KERFO
C                                                                       KERFO
    2 IF (BDLEN.LT.48.) GO TO 1                                         KERFO
C                                                                       KERFO
C   DETERMINE HALF-WIDTH AT MID-LENGTH OF BOARD                         KERFO
C                                                                       KERFO
      RM = RI+(L-BDLEN/2.)*TAN(RAD(LOG$))                               KERFO
      IF (DISTBD.GT.RM) GO TO 3                                         KERFO
      BOARDW = SQRT(RM**2-DISTBD**2)                                    KERFO
      IF (WMB.LT.BOARDW) BOARDW = WMB                                   KERFO
C                                                                       KERFO
C   BOARD MUST BE AT LEAST 3 INCHES WIDE AT MID-LENGTH                  KERFO
C                                                                       KERFO
      IF (BOARDW.LT.1.5) GO TO 3                                        KERFO
C                                                                       KERFO
C   DETERMINE HALF-WIDTH AT TOP OF BOARD                                KERFO
C                                                                       KERFO
      RT = RI+(L-BDLEN)*TAN(RAD(LOG$))                                  KERFO
      IF (DISTBD.GT.RT) GO TO 3                                         KERFO
      WT = SQRT(RT**2-DISTBD**2)                                        KERFO
      IF (WMB.LT.WT) WT = WMB                                           KERFO
C                                                                       KERFO
C   BOARD MUST BE AT LEAST 2.5 INCHES WIDE AT THE TOP                   KERFO
C                                                                       KERFO
      IF (WT.LT.1.25) GO TO 3                                           KERFO
C                                                                       KERFO
C   LIMIT THE TOTAL WANE TO AVOID GENERATING MORE DEFECTS THAN THE      KERFO
C   GRADING PROGRAM CAN HANDLE.  TOTAL WIDTH OF WANE MUST BE LESS       KERFO
C   THAN 4 INCHES                                                       KERFO
C                                                                       KERFO
      WAN = BOARDW-WT                                                   KERFO
      IF (WAN.GT.2.) GO TO 3                                            KERFO
C                                                                       KERFO
C   CONVERT BOARD WIDTH AND LENGTH TO EVEN QUARTER INCHES               KERFO
C                                                                       KERFO
      BOARDW = INT(BOARDW*8.)/8.                                        KERFO
      BDLEN = INT(BDLEN*4.)/4.                                          KERFO
C                                                                       KERFO
C   DEFINE BOARD EDGES IN QUARTER INCH UNITS                            KERFO
C                                                                       KERFO
      FLX(26,1) = BDLEN*4.                                              KERFO
      FLY(26,1) = BOARDW*8.                                             KERFO
      FUX(26,1) = 0.0                                                   KERFO
      FUY(26,1) = 0.0                                                   KERFO
C                                                                       KERFO
C   CALCULATE UNROUNDED BOARD FEET                                      KERFO
C                                                                       KERFO
      BF = BDLEN*BOARDW/2.*T/144.                                       KERFO
      RETURN                                                            KERFO
C                                                                       KERFO
C   CUT BACK BOARD BY ONE FOOT                                          KERFO
C                                                                       KERFO
    3 BDLEN = BDLEN-12.                                                 KERFO
      GO TO 2                                                           KERFO
      END                                                               KERFO
```

*** STATEMENT NUMBERS ***

```
    1      *25    47
    2      *47    98
    3       52    58    63    69    76   *97
```

*** VARIABLES ***

```
BDLEN       11   *27   *43    47    51    62   *81    85    92   *97
BF          11   *92
BOARDW      11   *53   *54    58    75   *80    86    92
D           11    24
DISTBD      11   *32    33    34    52    53    63    64
F            6    10    34    38
FLX          9    11   *85
FLY          9    11   *86
FUX          9    11   *87
FUY          9    11   *88
ID          10    11
INT         80    81
K           11    25    33    38
KERFQ        6
KNOT$       11
L           11    27    51    62
LOG$        11    39    51    62
NBD          6   *26    38
NODEFC      10    11
POSLEN     *39    43
R           11   *25    31    32    39
RAD         39    51    62
RB          11    32
RI         *24    51    62
RM         *51    52    53
RT         *62    63    64
SQRT        53    64
T           11    25    33    38    92
TAN         39    51    62
WAN        *75    76
WMB        *33   *34   *38    54    65
WT         *64   *65    69    75
```

Subroutine WANE

```
 1 C   SUBROUTINE 'WANE' LOCATES WANE DEFECTS ON THE BOARD                  WANEQ
 2 C                                                                       WANEQ
 3 C                                                                       WANEQ
 4       SUBROUTINE WANEQ                                                  WANEQ
 5 C                                                                       WANEQ
 6 C   THE BOARD EDGE HAS A NEW WANE DEFECT IF THE WIDTH DROPS BY 1/2      WANEQ
 7 C   INCH (1/4 INCH FOR EACH SIDE) FROM THAT AT THE MIDDLE.  THE BOARD   WANEQ
 8 C   IS SYMMETRICAL SO THE WANE DEFECTS OCCUR AT THE SAME PLACE ON       WANEQ
 9 C   BOTH EDGES OF THE BOARD                                             WANEQ
10 C                                                                       WANEQ
11       IMPLICIT REAL (K,L)                                               WANEQ
12       INTEGER ID(22,2),NODEFC(2)                                        WANEQ
13       REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                      WANEQ
14       COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,BF     WANEQ
15      1      /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                          WANEQ
16 C                                                                       WANEQ
17 C                                                                       WANEQ
18       CON1 = TAN(RAD(LOG$))                                             WANEQ
19       CON2 = DISTBD**2                                                  WANEQ
20       IF ((RB-SQRT(CON2+BOARDW**2))/CON1.GE.BDLEN) RETURN               WANEQ
21       OLDH = BDLEN*2.                                                   WANEQ
22       V = 0.                                                            WANEQ
23 C                                                                       WANEQ
24 C   FIND THE PLACE ALONG THE BOARD WHERE THE HALF-WIDTH HAS DECREASED    WANEQ
25 C   BY 1/4 INCH.  THE DEFECT ENDS HERE AND EXTENDS FROM THE END OF THE  WANEQ
26 C   LAST WANE DEFECT (OR FROM THE MIDDLE OF THE BOARD)                  WANEQ
27 C                                                                       WANEQ
28    1 V = V+0.25                                                         WANEQ
29       SQR = SQRT(CON2+(BOARDW-V)**2)                                    WANEQ
30       H = INT(AMIN1((RB-SQR)*4./CON1,BDLEN*4.))                         WANEQ
31       NODEFC(1) = NODEFC(1)+1                                           WANEQ
32       M = NODEFC(1)                                                     WANEQ
33 C                                                                       WANEQ
34 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)  WANEQ
35 C                                                                       WANEQ
36       IF (M.GT.22) GO TO 2                                              WANEQ
37 C                                                                       WANEQ
38 C   SAVE WANE COORDINATES FOR GRADING PROGRAM                           WANEQ
39 C                                                                       WANEQ
40       FUY(M,1) = V*4.+1.                                                WANEQ
41       FLY(M,1) = 0.                                                     WANEQ
42       FUX(M,1) = H                                                      WANEQ
43       FLX(M,1) = OLDH                                                   WANEQ
44       ID(M,1) = 5                                                       WANEQ
45 C                                                                       WANEQ
46 C   SINCE THE BOARD IS SYMMETRICAL, USE THE PREVIOUSLY GENERATED HEIGHT WANEQ
47 C   FOR THE WANE DEFECTS ON THE OTHER EDGE OF THE BOARD                 WANEQ
48 C                                                                       WANEQ
49    2 NODEFC(1) = NODEFC(1)+1                                            WANEQ
50       M = NODEFC(1)                                                     WANEQ
51       IF (M.GT.22) GO TO 3                                              WANEQ
52       FLY(M,1) = BOARDW*8.-V*4.-1.                                      WANEQ
53       FUY(M,1) = BOARDW*8.                                              WANEQ
54       FUX(M,1) = H                                                      WANEQ
55       FLX(M,1) = OLDH                                                   WANEQ
56       ID(M,1) = 5                                                       WANEQ
57 C                                                                       WANEQ
58 C   WHEN THE DEFECT EXTENDS TO THE END OF THE BOARD, EXIT               WANEQ
59 C                                                                       WANEQ
60    3 IF (H.GE.BDLEN*4.) RETURN                                          WANEQ
61 C                                                                       WANEQ
62 C   THE NEXT WANE DEFECT BEGINS WHERE THIS ONE ENDS                     WANEQ
63 C                                                                       WANEQ
64       OLDH = H                                                          WANEQ
65       GO TO 1                                                           WANEQ
66       RETURN                                                            WANEQ
67       END                                                               WANEQ
```

*** STATEMENT NUMBERS ***

1	*20	65	
2	36	*49	
3	51	*60	

*** VARIABLES ***

AMIN1	30												
BDLEN	14	20	21	30	60								
BF	14												
BOARDW	14	20	29	52	53								
CON1	*18	20	30										
CON2	*19	20	29										
D	14												
DISTBD	14	19											
FLX	13	14	*43	*55									
FLY	13	14	*41	*52									
FUX	13	14	*42	*54									
FUY	13	14	*40	*53									
H	*30	42	54	60	64								
ID	12	14	*44	*56									
INT	30												
K	14												
KNOT$	14												
L	14												
LOG$	14	18											
M	*32	36	40	41	42	43	44	*50	51	52	53	54	
	55	56											
NODEFC	12	14	*31	32	*49	50							
OLDH	*21	43	55	*64									
R	14												
RAD	18												
RB	14	20	30										
SQR	*29	30											
SQRT	20	29											
T	14												
TAN	18												
V	*22	*28	29	40	52								
WANEQ	4												

Subroutine KNOT

```
C   SUBROUTINE 'KNOT' LOCATES THE KNOT DEFECTS ON THE BOARD FACE.
C   ANGLES ARE MEASURED CLOCKWISE WITH 0 DEGREES DEFINED AS THE
C   LINE FROM THE CENTER OF THE LOG PERPENDICULAR TO THE BOARD FACE
C
C
      SUBROUTINE KNOT0 (KHIGH,KLEN,KTANG$)
C
      IMPLICIT REAL (K,L)
      INTEGER ID(22,2),NODEFC(2)
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)
      COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
     .      /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,BF
C
C
C   SEE IF THE KNOT IS LONG ENOUGH TO REACH THE BOARD FACE
C
      IF (KLEN.LT.DISTBD) RETURN
C
C   CALCULATE LOG RADIUS AT KNOT HEIGHT, BOARD HALF-WIDTH ANGLE, AND
C   KNOT DEFECT HALF-LENGTH AS PROJECTED ON THE FACE
C
      LRADUS = RB-KHIGH*TAN(RAD(LOG$))
      BDWID$ = DEG(ATAN(BOARDW/DISTBD))
      DY = DISTBD*TAN(RAD(KNOT$))
C
C   THE KNOT EFFECTIVELY ENDS AT THE OUTER EDGE OF THE LOG
C
      IF (KLEN.GT.LRADUS) KLEN = LRADUS
C
C   SINCE THE LOG IS TAPERED, THE OUTER BOARDS MAY NOT BE THE FULL LOG
C   LENGTH, SO KNOTS ABOVE THE END OF THE BOARD ARE NOT CONSIDERED
C
      IF (LRADUS.LT.DISTBD) RETURN
C
C   ANGLE OF ROTATION PUTS KNOT COMPLETELY OUTSIDE BOARD
C
      IF ((KTANG$.GT.180.).AND.((KTANG$+KNOT$).LT.(360.-BDWID$))) RETURN
      IF ((KTANG$.LE.180.).AND.((KTANG$-KNOT$).GT.BDWID$)) RETURN
C
C
C   FIND THE QUADRANT IN WHICH THE KNOT LIES (ASSUME QUADRANT ONE)
C
C   QUADRANT TWO
C
      IF ((KTANG$.LT.180.).AND.((KTANG$+KNOT$).GT.BDWID$)) GO TO 3
C
C   QUADRANT THREE
C
      IF ((KTANG$.GE.180.).AND.((KTANG$-KNOT$).LT.(360.-BDWID$)))
     .  GO TO 4
C
C   QUADRANT FOUR
C
      IF (KTANG$.GT.270.) GO TO 5
C
C
C   QUADRANT ONE
C
C   SEE IF KNOT CENTER IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES
C
      IF (KTANG$-KNOT$.LT.0.) GO TO 2
C
C   CALCULATE DISTANCE TO FACE ALONG BOTH SIDES OF KNOT
C
      ANGBD1 = DISTBD/COS(RAD(KTANG$-KNOT$))
      ANGBD2 = DISTBD/COS(RAD(KTANG$+KNOT$))
C
C   KNOT IS NOT LONG ENOUGH TO REACH FACE
C
      IF (KLEN.LT.ANGBD1) RETURN
C
C   FIND INTERSECTION OF NEAR SIDE OF KNOT AND FACE
C
      XP = BOARDW-DISTBD*TAN(RAD(KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD2) GO TO 1
C
C   FAR SIDE OF KNOT REACHES FACE
C
      XL = BOARDW-DISTBD*TAN(RAD(KTANG$+KNOT$))
      FULWID = (XR-XL)/2.
      GO TO 8
C
C   FAR SIDE OF KNOT DOES NOT REACH FACE
C
    1 XL = BOARDW-SQRT(KLEN**2-DISTBD**2)
      FULWID =
     .  DISTBD*TAN(RAD(KTANG$+KNOT$))-DISTBD*TAN(RAD(KTANG$-KNOT$))
      GO TO 8
C
C   KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES
C
    2 XL = AMIN1(SQRT(KLEN**2-DISTBD**2),DISTBD*TAN(RAD(KNOT$+KTANG$)))
      XL = BOARDW-XL
      XR = AMIN1(SQRT(KLEN**2-DISTBD**2),DISTBD*TAN(RAD(KNOT$-KTANG$)))
      XR = BOARDW+XR
C
C   KNOTS NEARLY PERPENDICULAR HAVE THEIR WIDTH ESTIMATED BY THEIR
C   LENGTH
C
      FULWID = DY*2.
      GO TO 8
C
C   QUADRANT TWO
C
    3 ANGBD1 = DISTBD/COS(RAD(KTANG$-KNOT$))
C
C   TOO SHORT TO REACH FACE
C
      IF (KLEN.LT.ANGBD1) RETURN
      XP = BOARDW-SQRT(ANGBD1**2-DISTBD**2)
      XL = BOARDW-SQRT(KLEN**2-DISTBD**2)
      IF ((KTANG$+KNOT$).GE.89.5)
     .  FULWID = LRADUS-DISTBD*TAN(RAD(KTANG$-KNOT$))
      IF ((KTANG$+KNOT$).LT.89.5)
     .  FULWID = AMIN1(LRADUS,DISTBD*TAN(RAD(KTANG$+KNOT$)))
     .    -DISTBD*TAN(RAD(KTANG$-KNOT$))
      GO TO 8
C
C   QUADRANT THREE
C
    4 ANGBD1 = DISTBD/COS(RAD(360.-KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD1) RETURN
      XR = BOARDW+SQRT(KLEN**2-DISTBD**2)
      XL = BOARDW+SQRT(ANGBD1**2-DISTBD**2)
      IF ((KTANG$-KNOT$).LE.270.5)
     .  FULWID = LRADUS-DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      IF ((KTANG$-KNOT$).GT.270.5)
     .  FULWID = AMIN1(LRADUS,DISTBD*TAN(RAD(360.-KTANG$+KNOT$)))
     .    -DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      GO TO 8
C
C   QUADRANT FOUR
C
    5 IF (360.-KTANG$-KNOT$.LT.0.) GO TO 7
      ANGBD1 = DISTBD/COS(RAD(360.-KTANG$-KNOT$))
      ANGBD2 = DISTBD/COS(RAD(360.-KTANG$+KNOT$))
      IF (KLEN.LT.ANGBD1) RETURN
      XL = BOARDW+DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD2) GO TO 6
C
C   FAR SIDE OF KNOT REACHES FACE
C
      XR = BOARDW+DISTBD*TAN(RAD(360.-KTANG$+KNOT$))
      FULWID = (XR-XL)/2.
      GO TO 8
C
C   FAR SIDE OF KNOT DOES NOT REACH FACE
C
    6 XP = BOARDW+SQRT(KLEN**2-DISTBD**2)
      FULWID = DISTBD*TAN(RAD(360.-KTANG$+KNOT$))
     .  -DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      GO TO 8
C
C
```

```
154 C   KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES              KNOTO
155 C                                                                KNOTO
156     7 XL = AMIN1(SQRT(KLEN**2-DISTBD**2),                        KNOTO
157      .  DISTBD*TAN(RAD(KTANGS+KNOTS-360.)))                      KNOTO
158       XL = BOARDW-XL                                             KNOTO
159       XR = AMIN1(SQRT(KLEN**2-DISTBD**2),                        KNOTO
160      .  DISTBD*TAN(RAD(360.-KTANGS+KNOTS)))                      KNOTO
161       XR = BOARDW+XR                                             KNOTO
162       FULWID = DY*2.                                             KNOTO
163 C                                                                KNOTO
164 C   IF A KNOT COMPLETELY INTERSECTS THE FACE, ITS LENGTH IS EXACTLY AS   KNOTO
165 C   MEASURED ON THE FACE.  OTHERWISE, ITS LENGTH IS ESTIMATED AS A       KNOTO
166 C   PROPORTION OF ITS PROJECTED LENGTH                           KNOTO
167 C                                                                KNOTO
168     8 DY = AMIN1(DY,DY*((XR-XL)*2./FULWID))                      KNOTO
169       YB = KHIGH-DY                                              KNOTO
170       YT = KHIGH+DY                                              KNOTO
171 C                                                                KNOTO
172 C   DEFECT LOCATIONS FOUND.  CHECK THAT THEY DO NOT EXTEND BEYOND THE    KNOTO
173 C   BOARD EDGES AND CONVERT TO QUARTER INCH UNITS FOR THE GRADING        KNOTO
174 C   PROGRAM                                                      KNOTO
175 C                                                                KNOTO
176       XL = AMAX0(0,INT(XL*4.))                                   KNOTO
177       XR = AMIN0(INT(BOARDW*8.),INT(XR*4.+1.))                   KNOTO
178       YB = AMAX0(0,INT(YB*4.))                                   KNOTO
179       YT = AMIN0(INT(BDLEN*4.),INT(YT*4.+1.))                    KNOTO
180 C                                                                KNOTO
181 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)   KNOTO
182 C                                                                KNOTO
183       NODEFC(1) = NODEFC(1)+1                                    KNOTO
184       IF (NODEFC(1).GT.22) RETURN                                KNOTO
185 C                                                                KNOTO
186 C   SAVE KNOT COORDINATES FOR GRADING PROGRAM                    KNOTO
187 C                                                                KNOTO
188       ID(NODEFC(1),1) = 3                                        KNOTO
189       FLY(NODEFC(1),1) = XL                                      KNOTO
190       FLX(NODEFC(1),1) = YB                                      KNOTO
191       FUY(NODEFC(1),1) = XR                                      KNOTO
192       FUX(NODEFC(1),1) = YT                                      KNOTO
193       RETURN                                                     KNOTO
194       END                                                        KNOTO
```

	142	148	158	161	177							
COS	65	66	104	120	134	135						
D	11											
DEG	23											
DISTBD	11	17	23	24	33	65	66	74	78	84	85	91
	93	104	109	110	111	113	120	122	123	124	126	134
	135	137	142	148	149	156	159					
DY	*24	99	162	*168	169	170						
FLX	10	11	*190									
FLY	10	11	*189									
FULWID	*79	*85	*99	*111	*113	*124	*126	*143	*149	*162	168	
FUX	10	11	*192									
FUY	10	11	*191									
ID	9	11	*188									
INT	176	177	178	179								
K	11											
KHIGH	6	22	169	170								
KLEN	6	17	*20	70	75	84	91	93	108	110	121	122
	136	138	148	156	159							
KNOTS	11	24	37	38	45	49	61	65	66	74	78	85
	91	93	104	111	113	120	124	126	133	134	135	137
	142	149	156	159								
KNOTO	6											
KTANGS	6	37	38	45	49	54	61	65	66	74	78	85
	91	93	104	111	113	120	124	126	133	134	135	137
	142	149	156	159								
L	11											
LOGS	11	22										
LRADUS	*22	28	33	111	113	124	126					
NODEFC	9	11	*183	184	188	189	190	191	192			
R	11											
RAD	22	24	65	66	74	78	85	91	93	104	111	113
	120	124	126	134	135	137	142	149	156	159		
RB	11	22										
SQRT	84	91	93	109	110	122	123	148	156	159		
T	11											
TAN	22	24	74	78	85	91	93	111	113	124	126	137
	142	149	156	159								
XL	*78	79	*81	*91	*92	*110	*123	*137	143	*156	*158	168
	*176	189										
XR	*71	73	*93	*94	*109	*122	*142	143	*148	*159	161	168
	*177	191										
YB	*169	*178	190									
YT	*170	*179	192									

*** STATEMENT NUMBERS ***

1	75	*84						
2	61	*91						
3	45	*104						
4	49	*120						
5	54	*133						
6	130	*148						
7	133	*156						
8	80	87	100	116	129	144	151	*168

*** VARIABLES ***

AMAX0	176	178										
AMIN0	177	179										
AMIN1	91	93	113	126	156	159	168					
ANGBD1	*65	70	*104	108	109	*120	121	123	*134	136		
ANGBD2	*66	75	*135	138								
ATAN	23											
BDLEN	11	179										
BDWIDS	*23	37	38	45	49							
BF	11											
BOARDW	11	23	74	78	84	92	94	109	110	122	123	137

Subroutine CORE

```
 1 C   SUBROUTINE 'CORE' LOCATES THE CORE DEFECT ON THE BOARD FACE
 2 C
 3 C
 4       SUBROUTINE COREQ (CRADUS,COFSET,CANG$)
 5 C
 6       IMPLICIT REAL (K,L)
 7       REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)
 8       INTEGER NODEFC(2),ID(22,2)
 9       COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,BF
10              /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
11 C
12 C
13 C   FIND DISTANCE TO THE BOARD FACE FROM THE CENTER OF THE CORE. EXIT
14 C   IF THE BOARD FACE IS BEYOND THE CORE RADIUS
15 C
16       TDIST = DISTBD-COFSET*COS(RAD(CANG$))
17       IF (CRADUS.LE.TDIST) RETURN
18       NODEFC(1) = NODEFC(1)+1
19 C
20 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)
21 C
22       IF (NODEFC(1).GT.22) RETURN
23 C
24 C   LOCATE THE CENTER POINT OF THE INTERSECTION OF THE BOARD FACE AND
25 C   THE CORE DEFECT.  CALCULATE THE DISTANCE ON THE BOARD FROM THE
26 C   CENTER POINT TO THE EDGES OF THE CORE DEFECT.  THE CORE DEFECT
27 C   IS NOT TAPERED, SO IT WILL EXTEND THE FULL LENGTH OF THE BOARD
28 C
29       CONST = SQRT(CRADUS**2-TDIST**2)
30       TBDCTR = COFSET*SIN(RAD(CANG$))
31       XR = BOARDW*CONST-TBDCTR
32       XL = BOARDW-CONST-TBDCTR
33 C
34 C   SAVE CORE DEFECT COORDINATES FOR GRADING PROGRAM
35 C
36       FUX(NODEFC(1),1) = INT(BDLEN*4.)
37       FLX(NODEFC(1),1) = 0.0
38       FUY(NODEFC(1),1) = AMIN0(INT(BOARDW*8.),INT(XR*4.+1.))
39       FLY(NODEFC(1),1) = AMAX0(0,INT(XL*4.))
40       ID(NODEFC(1),1) = 7
41       RETURN
42       END
```

COREQ

KNOT$	9								
L	9								
LOG$	9								
NODEFC	8	9	*18	22	36	37	38	39	40
P	9								
RAD	16	30							
RB	9								
SIN	30								
SQRT	29								
T	9								
TBDCTR	*30	31	32						
TDIST	*16	17	29						
XL	*32	39							
XR	*31	38							

*** VARIABLES ***

AMAX0	39			
AMIN0	38			
BDLEN	9	36		
BF	9			
BOARDW	9	31	32	38
CANG$	4	16	30	
COFSET	4	16	30	
CONST	*29	31	32	
COREQ	4			
COS	16			
CRADUS	4	17	29	
D	9			
DISTBD	9	16		
FLX	7	9	*37	
FLY	7	9	*39	
FUX	7	9	*36	
FUY	7	9	*38	
ID	8	9	*40	
INT	36	38	39	
K	9			

Subroutine GRADE

```
 1 C   SUBROUTINE 'GRADE' CALLS THE U.S. FOREST PRODUCTS LABORATORY      GRADE
 2 C   GRADING PROGRAM                                                   GRADE
 3 C                                                                     GRADE
 4 C                                                                     GRADE
 5       SUBROUTINE GRADE (NPG)                                          GRADE
 6 C                                                                     GRADE
 7       INTEGER ID(22,2),NODEFC(2),IX(22)                               GRADE
 8       REAL FL(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                     GRADE
 9       COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                        GRADE
10 C                                                                     GRADE
11 C                                                                     GRADE
12       M = NODEFC(1)                                                   GRADE
13       IF (M.GT.22) GO TO 3                                            GRADE
14       IF (M.EQ.0) GO TO 2                                             GRADE
15       DO 1 J=1,M                                                      GRADE
16         IX(J) = ID(J,1)                                               GRADE
17     1 CONTINUE                                                        GRADE
18     2 NPG = 1                                                         GRADE
19       CALL GPD (M,IX,NPG,SM)                                          GRADE
20       RETURN                                                          GRADE
21 C                                                                     GRADE
22 C   IF NUMBER OF DEFECTS IS MORE THAN GRADING PROGRAM CAN HANDLE,     GRADE
23 C   THE GRADE IS NO GO                                                GRADE
24 C                                                                     GRADE
25     3 NPG = 5                                                         GRADE
26       WRITE (6,100)                                                   GRADE
27   100 FORMAT (' ','       DEFECT LIMIT EXCEEDED')                     GRADE
28       RETURN                                                          GRADE
29       END                                                             GRADE
```

*** STATEMENT NUMBERS ***

1	15	*17
2	14	*18
3	13	*25
100	26	*27

*** VARIABLES ***

FLX	8	9				
FLY	8	9				
FUX	8	9				
FUY	8	9				
GRADE	5					
GRD	19					
ID	7	9	16			
IX	7	*16	19			
J	*15	16				
M	*12	13	14	15	19	
NODEFC	7	9	12			
NPG	5	*18	19	*25		
SM	19					

Subroutine PRICE

```
 1 C   SUBROUTINE 'PRICE' DETERMINES THE BOARD GRADE BASED ON THE GRADES  PRICE0
 2 C   OF BOTH SIDES (OLD,NPG) AND CALCULATES THE BOARD VALUE             PRICE0
 3 C                                                                     PRICE0
 4 C                                                                     PRICE0
 5       SUBROUTINE PRICE0 (OLD,NPG,TVAL,PERC)                           PRICE0
 6 C                                                                     PRICE0
 7       IMPLICIT REAL (K,L)                                             PRICE0
 8       INTEGER OLD                                                     PRICE0
 9       REAL PERC(5)                                                    PRICE0
10       COMMON /PRICE/ FAS,SEL,ONEC,TWOC,THRB                           PRICE0
11      +       /BOARD/ L,D,K,T,LOG$,PB,DISTBD,BDLEN,BOARDW,KNOT$,R,BF  PRICE0
12 C                                                                     PRICE0
13 C                                                                     PRICE0
14 C   DETERMINE THE BOARD GRADE                                         PRICE0
15 C                                                                     PRICE0
16       IF (OLD.EQ.5.OR.NPG.EQ.5) GO TO 3                               PRICE0
17       IF (OLD.EQ.2.OR.NPG.EQ.2) GO TO 1                               PRICE0
18       IF (OLD.EQ.NPG) GO TO 4                                         PRICE0
19       NPG = MAX0(OLD,NPG)                                             PRICE0
20       IF (NPG.EQ.4) GO TO 8                                           PRICE0
21       NPG = 2                                                         PRICE0
22       GO TO 4                                                         PRICE0
23     1 IF (OLD.EQ.4.OR.NPG.EQ.4) GO TO 2                               PRICE0
24       NPG = 3                                                         PRICE0
25       GO TO 4                                                         PRICE0
26     2 NPG = 4                                                         PRICE0
27       GO TO 4                                                         PRICE0
28     3 NPG = 5                                                         PRICE0
29     4 GO TO (5,6,7,8,9), NPG                                          PRICE0
30 C                                                                     PRICE0
31 C   AND CALCULATE THE BOARD VALUE                                     PRICE0
32 C                                                                     PRICE0
33     5 V = BF*FAS                                                      PRICE0
34       GO TO 10                                                        PRICE0
35     6 V = BF*SEL                                                      PRICE0
36       GO TO 10                                                        PRICE0
37     7 V = BF*ONEC                                                     PRICE0
38       GO TO 10                                                        PRICE0
39     8 V = BF*TWOC                                                     PRICE0
40       GO TO 10                                                        PRICE0
41     9 V = BF*THRB                                                     PRICE0
42 C                                                                     PRICE0
43 C   INCREASE SURFACE MEASURE IN THIS GRADE AND THE TOTAL LOG VALUE    PRICE0
44 C                                                                     PRICE0
45    10 PERC(NPG) = BF+PERC(NPG)                                        PRICE0
46       TVAL = TVAL+V                                                   PRICE0
47       RETURN                                                          PRICE0
48       END                                                             PRICE0
```

*** STATEMENT NUMBERS ***

1	17	*23			
2	23	*26			
3	16	*28			
4	18	22	25	27	*29
5	29	*33			
6	29	*35			
7	29	*37			
8	20	29	*39		
9	29	*41			
10	31	36	38	40	*45

*** VARIABLES ***

BDLEN	10											
BF	10	33	35	37	39	41	45					
BOARDU	10											
D	10											
DISTBD	10											
FAS	10	33										
K	10											
KNOTS	10											
L	10											
LOGS	10											
MAXB	19											
NPG	5	16	17	18	*19	20	*21	23	*24	*26	*28	29
	45											
OLD	5	8	16	17	18	19	23					
ONEC	10	37										
PERC	5	9	*45									
PRICEQ	5											
R	10											
RB	10											
SEL	10	35										
T	10											
THRB	10	41										
TVAL	5	*46										
TWOC	10	39										
V	*33	*35	*37	*39	*41	46						

Function DEG

```
1 C   FUNCTION 'DEG' CONVERTS ITS ARGUMENT (IN RADIANS) TO DEGREES          DEG
2 C                                                                        DEG
3 C                                                                        DEG
4       FUNCTION DEG (A)                                                   DEG
5 C                                                                        DEG
6 C                                                                        DEG
7       DEG = A*180.0/3.141592                                             DEG
8       RETURN                                                             DEG
9       END                                                                DEG
```

*** VARIABLES ***

A	4	7
DEG	4	*7

Function RAD

```
1 C   FUNCTION 'RAD' CONVERTS ITS ARGUMENT (IN DEGREES) TO RADIANS          RAD
2 C                                                                         RAD
3 C                                                                         RAD
4       FUNCTION RAD (A)                                                    RAD
5 C                                                                         RAD
6 C                                                                         RAD
7       RAD = A*3.141592/180.0                                              RAD
8       RETURN                                                              RAD
9       END                                                                 RAD
```

**** VARIABLES ****

A	4	7
RAD	4	*7

Cant Sawing (CANT)

```
C   'CANT' CUTS FROM FACES 1 AND 3 LEAVING A CANT OF SPECIFIED
C   THICKNESS.  THIS CANT IS THEN TURNED 90 DEGREES AND CUT
C   INTO BOARDS
C
C
      IMPLICIT REAL (K,L)
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),PERC(5),ANGLE(50),
     .     HEIGHT(50),KTLEN(50),DAT*8
      INTEGER ID(22,2),NODEFC(2),OLD,F
      COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
     .      /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,CANT,R,BF
     .      /PRICE/ FAS,SEL,ONEC,TWOC,THRB
C
C
C   THIS PROGRAM ASSUMES INPUT FROM UNIT 5 AND OUTPUTS TO UNITS 6 AND 8
C
C   GET LOG DIAMETER (IN.), LOG LENGTH (IN.), KERF SIZE (IN.), AND
C   BOARD THICKNESS (IN.)
C
    1 READ (5,102,END=22) D
      READ (5,102) L
      READ (5,103) K
      READ (5,102) T
C
C   GET KNOT HALF-ANGLE (DEGREES) AND LOG HALF-TAPER (DEGREES)
C
      READ (5,102) KNOT$
      READ (5,102) LOG$
C
C   GET CORE DEFECT PARAMETERS: DIAMETER (IN.), LINEAR OFFSET (IN.),
C   AND ANGULAR OFFSET (DEGREES)
C
      READ (5,106) CORDIA
      READ (5,106) COFSET
      READ (5,106) CANG$
C
C   GET PRICE PER BOARD FOOT FOR EACH GRADE: NUMBER OF KNOTS
C
      READ (5,105) FAS,SEL,ONEC,TWOC,THRB
      READ (5,108) MAX
C
C   GET DATE AND CALCULATE RADIUS OF CORE DEFECT
C
      CALL DATE (DAT)
      CRADUS = CORDIA/2.
C
C   GET KNOT ANGLES, HEIGHTS, AND LENGTHS
C
      DO 2 J=1,MAX
        READ (5,104) ANGLE(J),HEIGHT(J)
    2 CONTINUE
      DO 3 J=1,MAX
        READ (5,106) KTLEN(J)
    3 CONTINUE
C
C   CALCULATE LOG RADIUS AT TOP AND BOTTOM; TOTAL LOG CUBIC FEET
C
      RT = D/2.
      RB = RT+L*TAN(RAD(LOG$))
      LVOL = 1/3.*3.14159*(RB**2+RB*RT+RT**2)*L/144.
C
C   CALCULATE CENTRAL CANT SIZE
C
      CANT = D/2.-2.
C
C   OUTPUT HEADER
C
      WRITE (6,116) DAT
      WRITE (6,117) L,D,LOG$,LVOL,CANT
      WRITE (6,101) MAX
      DO 4 J=1,MAX
        WRITE (6,105) ANGLE(J),HEIGHT(J),KTLEN(J)
    4 CONTINUE
      WRITE (6,118) KNOT$
      WRITE (6,110) CRADUS,COFSET,CANG$
      WRITE (6,119) K,T
      WRITE (6,120) FAS,SEL,ONEC,TWOC,THRB
      WRITE (8,200) L,D,MAX,CRADUS,COFSET,CANG$,LVOL,K,T,KNOT$,LOG$
      WRITE (8,201) (KTLEN(J),J=1,MAX)
      WRITE (8,201) (HEIGHT(J),J=1,MAX)
      WRITE (8,201) (ANGLE(J),J=1,MAX)
      WRITE (8,202) FAS,SEL,ONEC,TWOC,THRB
C
C   INITIALIZE VARIABLES FOR CALCULATING HIGH, LOW, AND AVERAGE
C   YIELDS FOR EACH LOG
C
      HIGH$ = 0.
      SMALL$ = 999.
      AVG$ = 0.
C
C   SAW LOG IN 12 DIFFERENT ROTATIONAL POSITIONS, 15 DEGREES APART, TO
C   DETERMINE THE ORIENTATION GIVING THE HIGHEST YIELD
C
      DO 21 INX=1,12
C
C   INITIALIZE FOR EACH POSITION
C
        NBD = 1
        TVAL = 0.0
        BF = 0.0
C
C   CUTTING ORDER IS FACE 1, FACE 3, FACE 4, AND FACE 2
C
        DO 5 J=1,5
          PERC(J) = 0.0
    5   CONTINUE
C
C   FOR FOUR FACES OF THE LOG...
C
        DO 16 F=1,4
C
C   THE SLAB FACES ARE CUT TO THE DEFINED CANT
C
          IF (F.EQ.1.OR.F.EQ.2) R = RB-CANT/2.
C
C   THE CANT FACES ARE KERF CENTERED TO DIVIDE THE CANT
C
          IF (F.EQ.3.OR.F.EQ.4) R = RB+K/2.
C
C   CUT BOARDS FROM THIS FACE UNTIL FACE IS COMPLETELY CUT.  THE LOG IS
C   CUT FROM THE INSIDE OUT
C
    6     CALL KERFC (&11,F)
C
C   FOR BOTH SIDES OF THE BOARD...
C
          DO 10 I=1,2
C
C   INITIALIZE DEFECT ARRAYS, EXCEPT F..(26,1), WHICH HOLDS THE BOARD
C   DIMENSIONS
C
            DO 7 J=1,25
              FLX(J,I) = -9999.0
              FUX(J,I) = -9999.0
              FLY(J,I) = -9999.0
              FUY(J,I) = -9999.0
    7       CONTINUE
            DO 8 J=1,22
              ID(J,I) = 0
    8       CONTINUE
            NODEFC(I) = 0
C
C   PUT IN WANE DEFECTS
C
            CALL WANEC
C
C   PUT IN KNOTS
C
            DO 9 J=1,MAX
              CALL KNOTC(HEIGHT(J),KTLEN(J),ANGLE(J))
```

```
151      9       CONTINUE                                                  CANT
152 C                                                                      CANT
153 C   PUT IN CORE DEFECT                                                 CANT
154 C                                                                      CANT
155             CALL COREC (CRADUS,COFSET,CANG$)                           CANT
156 C                                                                      CANT
157 C   AND GRADE THE FACE                                                 CANT
158 C                                                                      CANT
159             CALL GRADE (NPG)                                           CANT
160 C                                                                      CANT
161 C   SAVE GRADE OF FIRST SIDE OF BOARD                                  CANT
162 C                                                                      CANT
163             IF (I.EQ.1) OLD = NPG                                      CANT
164 C                                                                      CANT
165 C   SUBTRACT BOARD THICKNESS AND PROCESS THE INNER FACE                CANT
166 C                                                                      CANT
167             DISTBD = DISTBD-T                                          CANT
168     10      CONTINUE                                                   CANT
169 C                                                                      CANT
170 C   DETERMINE BOARD GRADE AND VALUE BASED ON GRADES OF BOTH FACES      CANT
171 C                                                                      CANT
172           CALL PRICEC (OLD,NPG,TVAL,PERC)                              CANT
173 C                                                                      CANT
174 C   INCREASE BOARD COUNT AND CUT ANOTHER BOARD                         CANT
175 C                                                                      CANT
176           NBD  =  NBD + 1                                              CANT
177           GO TO 6                                                      CANT
178 C                                                                      CANT
179 C   TURN LOG TO NEXT FACE                                              CANT
180 C                                                                      CANT
181     11      GO TO (12,14,12,16), F                                     CANT
182 C                                                                      CANT
183 C   TURN LOG BY 180 DEGREES TO CUT THE OPPOSITE FACE.                  CANT
184 C                                                                      CANT
185     12      DO 13 J=1,MAX                                              CANT
186               ANGLE(J) = AMOD(ANGLE(J)+180.0,360.0)                    CANT
187     13      CONTINUE                                                   CANT
188             CANG$ = AMOD(CANG$+180.0,360.0)                            CANT
189             GO TO 16                                                   CANT
190 C                                                                      CANT
191 C   OR TURN 90 DEGREES TO CUT A CANT FACE                              CANT
192 C                                                                      CANT
193     14      DO 15 J=1,MAX                                              CANT
194               ANGLE(J) = AMOD(ANGLE(J)+90.0,360.0)                     CANT
195     15      CONTINUE                                                   CANT
196             CANG$ = AMOD(CANG$+90.0,360.0)                             CANT
197     16    CONTINUE                                                     CANT
198 C                                                                      CANT
199 C   LOG HAS BEEN COMPLETELY CUT...RETURN ANGLES TO ORIGINAL VALUES     CANT
200 C                                                                      CANT
201         DO 18 J=1,MAX                                                  CANT
202           ANGLE(J) = AMOD(ANGLE(J)+270.0,360.0)                        CANT
203     18    CONTINUE                                                     CANT
204         CANG$ = AMOD(CANG$+270.,360.)                                  CANT
205 C                                                                      CANT
206 C   PRINT RESULTS FOR THIS POSITION                                    CANT
207 C                                                                      CANT
208         IPOTAT = INX*15-15                                             CANT
209         WRITE (6,107) IROTAT                                           CANT
210         WRITE (6,111) (PERC(J),J=1,5)                                  CANT
211         TOTS = PERC(1)+PERC(2)+PERC(3)+PERC(4)+PERC(5)                 CANT
212         WRITE (6,112) TOTS                                             CANT
213         WRITE (8,203) IROTAT                                           CANT
214         WRITE (8,204) (PERC(J),J=1,5)                                  CANT
215         WRITE (8,204) TOTS                                             CANT
216         DO 19 J=1,5                                                    CANT
217           PERC(J) = PERC(J)/LVOL*100.                                  CANT
218     19    CONTINUE                                                     CANT
219         TOTS = TOTS*100./LVOL                                          CANT
220         WRITE (6,113) TOTS                                             CANT
221         WRITE (6,108) (ANGLE(J),J=1,MAX)                               CANT
222         WRITE (6,109) (PERC(J),J=1,5),TVAL                             CANT
223         WRITE (8,205) (PERC(J),J=1,5)                                  CANT
224         WRITE (8,204) TVAL,TOTS                                        CANT
225 C                                                                      CANT
226 C   SAVE HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG                     CANT
227 C                                                                      CANT
228         AVG$ = AVG$+TVAL                                               CANT
229         IF (TVAL.GT.HIGH$) HIGH$ = TVAL                                CANT
230         IF (TVAL.LT.SMALL$) SMALL$ = TVAL                              CANT
231 C                                                                      CANT
232 C   ROTATE LOG BY 15 DEGREES AND REPROCESS                              CANT
233 C                                                                      CANT
234         DO 20 J=1,MAX                                                  CANT
235           ANGLE(J) = AMOD(ANGLE(J)+15.0,360.0)                         CANT
236     20    CONTINUE                                                     CANT
237         CANG$ = AMOD(CANG$+15.0,360.0)                                 CANT
238     21 CONTINUE                                                        CANT
239 C                                                                      CANT
240 C   PRINT HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG                   CANT
241 C                                                                      CANT
242       AVG$ = AVG$/12.                                                  CANT
243       WRITE (6,114) HIGH$,AVG$,SMALL$                                  CANT
244 C                                                                      CANT
245 C   LOG COMPLETELY PROCESSED, READ PARAMETERS FOR NEXT LOG              CANT
246 C                                                                      CANT
247       GO TO 1                                                          CANT
248 C                                                                      CANT
249     22 STOP                                                            CANT
250 C                                                                      CANT
251 C   FORMATS FOR DEVICE 6 (PRINTER)                                     CANT
252 C                                                                      CANT
253   100 FORMAT (I2)                                                      CANT
254   101 FORMAT ('1THERE ARE',I3,' KNOTS IN THIS LOG.  ',2(/),4X,         CANT
255      .  ' ANGLE  HEIGHT   LENGTH')                                     CANT
256   102 FORMAT (F5.1)                                                    CANT
257   103 FORMAT (F5.3)                                                    CANT
258   104 FORMAT (2F6.2)                                                   CANT
259   105 FORMAT (3(2X,F6.2))                                              CANT
260   106 FORMAT (F6.3)                                                    CANT
261   107 FORMAT (2(/),' ROTATION IS',I4)                                  CANT
262   108 FORMAT (' KNOT ANGLES: ',15F7.2,2(/,13X,15F7.2))                 CANT
263   109 FORMAT (' % AVAILABLE SURFACE MEASURE IN EACH GRADE ',5F5.1,      CANT
264      .  'LOG VALUE IS $',F6.2)                                         CANT
265   110 FORMAT (' CORE DEFECT RADIUS ',F6.3,'  LINEAR OFFSET ',F6.3,     CANT
266      .  '  ANGULAR OFFSET ',F6.3)                                      CANT
267   111 FORMAT (' SURFACE MEASURE/GRADE IS',5F7.2)                       CANT
268   112 FORMAT (' TOTAL SURFACE MEASURE IS ',F8.2)                       CANT
269   113 FORMAT (' TOTAL PERCENT YIELD IS',F8.2)                          CANT
270   114 FORMAT (' $ YIELD:  HIGH ',F6.2,'  AVERAGE ',F6.2,'  LOW ',F6.2) CANT
271   115 FORMAT (5F10.4)                                                  CANT
272   116 FORMAT (' CANT SAWING METHOD ',A8)                               CANT
273   117 FORMAT (' LOG PARAMETERS:  LENGTH',F6.1,'  DIA',F6.1,'  TAPER'   CANT
274      .  F6.4,'DEGREES  LOG VOLUME',F8.2,'  CANT SIZE',F6.2)            CANT
275   118 FORMAT (' ANGLES MEASURED FROM ZERO DEGREES = EAST FOR A         CANT
276      .  'VERTICALLY CUTTING SAW.  KNOT TAPER',F6.2)                    CANT
277   119 FORMAT (' CUTTING PARAMETERS:  KERF',F6.4,'  BOARD THICKNESS'    CANT
278      .  F5.2)                                                          CANT
279   120 FORMAT (' PRICES PER BOARD FOOT: ',5F10.4)                       CANT
280 C                                                                      CANT
281 C   FORMATS FOR DEVICE 8 (STORAGE MEDIUM)                              CANT
282 C                                                                      CANT
283   200 FORMAT (F6.1,F5.1,I3,3F5.1,F8.2,F6.3,F4.1,F6.2,F5.3,F6.3)       CANT
284   201 FORMAT (3(10F7.2,/))                                             CANT
285   202 FORMAT (5F7.4)                                                   CANT
286   203 FORMAT (I3)                                                      CANT
287   204 FORMAT (5F8.2)                                                   CANT
288   205 FORMAT (10F6.2)                                                  CANT
289       END                                                              CANT
```

*** STATEMENT NUMBERS ***

1	*28	247
2	49	*51
3	52	*54
4	71	*73

```
    5     184  *186
    6    *123   177
    7     132  *137
    8     138  *148
    9     149  *151
   10     127  *168
   11     123  *181
   12     181  *185
   13     185  *187
   14     181  *193
   15     193  *195
   16     110   181   189  *197
   18     201  *203
   19     216  *218
   20     234  *236
   21      94  *238
   22      28  *249
  100      40  *253
  101      70  *254
  102      20    21    23    27    28  *256
  103      22  *257
  104      50  *258
  105      72  *259
  106      33    34    35    53  *260
  107     209  *261
  108     221  *262
  109     222  *263
  110      75  *265
  111     210  *267
  112     212  *268
  113     220  *269
  114     243  *270
  115      39  *271
  116      68  *272
  117      69  *273
  118      74  *275
  119      76  *277
  120      77  *279
  200      78  *283
  201      79    80    81  *284
  202      82  *285
  203     213  *286
  204     214   215   224  *287
  205     223  *288
```

*** VARIABLES ***

```
AMOD      186   188   194   196   202   204   235   237
ANGLE       7   *50    72    81   150  *186  *194  *202   221  *235
AVG$      *89  *228  *242   243
BDLEN      10
BF         10  *100
BOARDW     10
CANG$     *35    75    78   155  *188  *196  *204  *237
CANT       10   *64    69   114
COFSET    *34    75    78   155
CORDIA    *33    45
COREC     155
CRADUS    *45    75    78   155
D          10   *20    58    64    69    78
DAT         7    44    68
DATE       44
DISTBD     10  *167
F           9  *110   114   118   123   181
FAS        10   *39    77    82
FLX         7    10  *133
FLY         7    10  *135
FUX         7    10  *134
FUY         7    10  *136
GRADE     159
HEIGHT      7   *50    72    80   150
HIGH$     *87  *229   243
I        *127   163
ID          9    10  *139
INX       *94   200
IROTAT    *208   209   213
J          *49   *50   *52   *53   *71    72    79    80    81  *104   105  *132
           133   134   135   136  *138   139  *149   150  *105   106  *193   194
          *201   202   210   214  *216   217   221   222   223  *234   235
K          10   *22    76    78   118
KERFC     123
KNOT$      10   *27    74    78
KNOTC     150
KTLEN       7   *53    72    79   150
L          10   *21    59    60    69    78
LOG$       10   *28    59    69    78
LVOL      *60    69    78   217   219
MAX       *40    49    52    70    71    78    79    80    81   149   185   193
           201   221   234
NBD       *98  *176
NODEFC      9    10  *141
NPG       159   163   172
OLD         9  *163   172
ONEC       10   *39    77    82
PERC        7  *105   172   210   211   214  *217   222   223
PRICEC    172
R          10  *114  *118
RAD        59
RB         10   *59    60   114   118
RI        *58    59    60
SEL        10   *39    77    82
SMALL$    *88  *230   243
T          10   *23    76    78   167
TAN        59
THRB       10   *39    77    82
TOTS      *211   212   215  *219   220   224
TVAL      *99   172   222   224   228   229   230
TWOC       10   *39    77    82
WIDEC     147
```

Subroutine KERF

```
C   SUBROUTINE 'KERF' CUTS A BOARD FROM THE LOG.  THE BOARD WIDTH IS
C   DEFINED AT THE CENTER, AND THE BOARD LENGTH FROM THE BUTTOM
C   OF THE LOG
C
C
      SUBROUTINE KERFC (*,F)
C
      IMPLICIT REAL (K,L)
      INTEGER ID(22,2),NODEFC(2),F
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)
      COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,CANT,R,BF
     1      /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
C
C
C   ALL BOARDS MUST BE AT LEAST 48 INCHES LONG, 2.5 INCHES WIDE AT
C   THE TOP, AND 3 INCHES WIDE AT THE CENTER.  IN ADDITION, THE TOTAL
C   AMOUNT OF WANE FROM THE CENTER TO THE TOP IS LIMITED TO 4 INCHES.
C   THE BOARD IS CUT BACK IN ONE FOOT INCREMENTS IF THE WIDTH OR WANE
C   TESTS FAIL.  IF THE LENGTH TEST FAILS, ANOTHER BOARD IS CUT FROM
C   THIS FACE
C
C
C   FIND OUTER FACE OF BOARD
C
      RI = D/2.
    1 R = R-T-K
      BDLEN = L
C
C   IF THIS FACE OF THE LOG IS COMPLETELY CUT, EXIT
C
      IF (R.LT.0.) RETURN1
      DISTBD = RB-R
      POSLEN = R*TAN(RAD(90.-LOG$))
C
C
C   CHECK FOR BOARDS SHORTER THAN THE LOG DUE TO LOG TAPER
C
      IF (POSLEN.LT.BDLEN) BDLEN = POSLEN
C
C   BOARDS MUST BE AT LEAST 4 FEET LONG
C
    2 IF (BDLEN.LT.48.) GO TO 1
C
C   DETERMINE HALF-WIDTH AT MID-LENGTH OF BOARD
C
      RM = D/2.+(L-BDLEN/2.)*TAN(RAD(LOG$))
      IF (DISTBD.GT.RM) GO TO 3
      BOARDW = SQRT(RM**2-DISTBD**2)
C
C   FOR CANT CUTS, BOARD IS NO WIDER THAN CANT
C
      IF (F.EQ.3.OR.F.EQ.4) BOARDW = AMIN1(CANT/2.,BOARDW)
C
C   BOARD MUST BE AT LEAST 3 INCHES WIDE AT MID-LENGTH
C
      IF (BOARDW.LT.1.5) GO TO 3
C
C   DETERMINE HALF-WIDTH AT TOP OF BOARD
C
      RT = D/2.+(L-BDLEN)*TAN(RAD(LOG$))
      IF (DISTBD.GT.RT) GO TO 3
      WT = SQRT(RT**2-DISTBD**2)
      IF (F.EQ.3.OR.F.EQ.4) WT = AMIN1(CANT/2.,WT)
C
C   BOARD MUST BE AT LEAST 2.5 INCHES WIDE AT THE TOP
C
      IF (WT.LT.1.25) GO TO 3
C
C   LIMIT THE TOTAL WANE TO AVOID GENERATING MORE DEFECTS THAN THE
C   GRADING PROGRAM CAN HANDLE.  TOTAL WIDTH OF WANE MUST BE LESS
C   THAN 4 INCHES
C
      WAN = BOARDW-WT
      IF (WAN.GT.2.0) GO TO 3
C
C   CONVERT BOARD WIDTH AND LENGTH TO EVEN QUARTER INCHES
C
      BOARDW = INT(BOARDW*8.)/8.
      BDLEN = INT(BDLEN*4.)/4.
C
C   DEFINE BOARD EDGES IN QUARTER INCH UNITS
C
      FLX(26,1) = BDLEN*4.
      FLY(26,1) = BOARDW*8.
      FUX(26,1) = 0.0
      FUY(26,1) = 0.0
C
C   CALCULATE UNROUNDED BOARD FEET
C
      BF = BDLEN*BOARDW/2.*T/144.
      RETURN
C
C   CUT BACK BOARD BY ONE FOOT
C
    3 BDLEN = BDLEN-12.
      GO TO 2
      END
```

*** STATEMENT NUMBERS ***

1	*26	42								
2	*42	96								
3	47	56	61	67	74	*95				

*** VARIABLES ***

AMIN1	52	63								
BDLEN	11	*27	*38	42	46	60	*79	83	90	*95
BF	11	*90								
BOARDW	11	*48	*52	56	73	*78	84	90		
CANT	11	52	63							
D	11	25	46	60						
DISTBD	11	*32	47	48	61	62				
F	6	9	52	63						
FLX	10	11	*83							
FLY	10	11	*84							
FUX	10	11	*85							
FUY	10	11	*86							
ID	9	11								
INT	78	79								
K	11	26								
KERFC	6									
KNOT$	11									
L	11	27	46	60						
LOG$	11	33	46	60						
NODEFC	9	11								
POSLEN	*33	38								
R	11	*26	31	32	33					
RAD	33	46	60							
RB	11	32								
RI	*25									
RM	*46	47	48							
RT	*60	61	62							
SQRT	48	62								
T	11	26	90							
TAN	33	46	60							
WAN	*73	74								
WT	*57	*63	67	73						

Subroutine WANE

```
 1 C   SUBROUTINE 'WANE' LOCATES WANE DEFECTS ON THE BOARD                  WANEC
 2 C                                                                        WANEC
 3 C                                                                        WANEC
 4         SUBROUTINE WANEC                                                 WANEC
 5 C                                                                        WANEC
 6 C   THE BOARD EDGE HAS A NEW WANE DEFECT IF THE WIDTH DROPS BY 1/2       WANEC
 7 C   INCH (1/4 INCH FOR EACH SIDE) FROM THAT AT THE MIDDLE.  THE BOARD    WANEC
 8 C   IS SYMMETRICAL SO THE WANE DEFECTS OCCUR AT THE SAME PLACE ON        WANEC
 9 C   BOTH EDGES OF THE BOARD                                              WANEC
10 C                                                                        WANEC
11         IMPLICIT REAL (K,L)                                              WANEC
12         INTEGER ID(22,2),NODEFC(2)                                       WANEC
13         REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                     WANEC
14         COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,CANT,R,BF WANEC
15                /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                         WANEC
16 C                                                                        WANEC
17 C                                                                        WANEC
18         CON1 = TAN(RAD(LOG$))                                            WANEC
19         CON2 = DISTBD**2                                                 WANEC
20         IF ((PB-SQRT(CON2+BOARDW**2))/CON1.GE.BDLEN) RETURN              WANEC
21         OLDH = BDLEN*2.                                                  WANEC
22         V = 0.                                                           WANEC
23 C                                                                        WANEC
24 C   FIND THE PLACE ALONG THE BOARD WHERE THE HALF-WIDTH HAS DECREASED    WANEC
25 C   BY 1/4 INCH.  THE DEFECT ENDS HERE AND EXTENDS FROM THE END OF THE   WANEC
26 C   LAST WANE DEFECT (OR FROM THE MIDDLE OF THE BOARD)                   WANEC
27 C                                                                        WANEC
28     1 V = V+0.25                                                         WANEC
29         SQR = SQRT(CON2+(BOARDW-V)**2)                                   WANEC
30         H = INT(AMIN1((PB-SQR)*4./CON1,BDLEN*4.))                        WANEC
31         NODEFC(1) = NODEFC(1)+1                                          WANEC
32         M = NODEFC(1)                                                    WANEC
33 C                                                                        WANEC
34 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)   WANEC
35 C                                                                        WANEC
36         IF (M.GT.22) GO TO 2                                             WANEC
37 C                                                                        WANEC
38 C   SAVE WANE COORDINATES FOR GRADING PROGRAM                            WANEC
39 C                                                                        WANEC
40         FLY(M,1) = 0.                                                    WANEC
41         FUY(M,1) = V*4.+1.                                               WANEC
42         FUX(M,1) = H                                                     WANEC
43         FLX(M,1) = OLDH                                                  WANEC
44         ID(M,1) = 5                                                      WANEC
45 C                                                                        WANEC
46 C   SINCE THE BOARD IS SYMMETRICAL, USE THE PREVIOUSLY GENERATED HEIGHT  WANEC
47 C   FOR THE WANE DEFECTS ON THE OTHER EDGE OF THE BOARD                  WANEC
48 C                                                                        WANEC
49     2 NODEFC(2) = NODEFC(2)+1                                            WANEC
50         M = NODEFC(2)                                                    WANEC
51         IF (M.GT.22) GO TO 3                                             WANEC
52         FLY(M,2) = BOARDW*8.-V*4.-1.                                     WANEC
53         FUY(M,2) = BOARDW*8.                                             WANEC
54         FUX(M,2) = H                                                     WANEC
55         FLX(M,2) = OLDH                                                  WANEC
56         ID(M,2) = 5                                                      WANEC
57 C                                                                        WANEC
58 C   WHEN THE DEFECT EXTENDS TO THE END OF THE BOARD, EXIT                WANEC
59 C                                                                        WANEC
60     3 IF (H.GE.BDLEN*4.) RETURN                                          WANEC
61 C                                                                        WANEC
62 C   THE NEXT WANE DEFECT BEGINS WHERE THIS ONE ENDS                      WANEC
63 C                                                                        WANEC
64         OLDH = H                                                         WANEC
65         GO TO 1                                                          WANEC
66         RETURN                                                           WANEC
67         END                                                              WANEC
```

*** STATEMENT NUMBERS ***

1	*28	65
2	36	*49
3	51	*60

*** VARIABLES ***

AMIN1	30											
BDLEN	14	20	21	30	60							
BF	14											
BOARDW	14	20	29	52	53							
CANT	14											
CON1	*18	20	30									
CON2	*19	20	29									
D	14											
DISTBD	14	19										
FLX	13	14	*43	*55								
FLY	13	14	*40	*52								
FUX	13	14	*42	*54								
FUY	13	14	*41	*53								
H	*30	42	54	60	64							
ID	12	14	*44	*56								
INT	30											
K	14											
KNOT$	14											
L	14											
LOG$	14	18										
M	*32	36	40	41	42	43	44	*58	51	52	53	54
	55	56										
NODEFC	12	14	*31	32	*49	50						
OLDH	*21	43	55	*64								
R	14											
RAD	18											
RB	14	20	30									
SQR	*29	30										
SQRT	20	29										
T	14											
TAN	18											
V	*22	*28	29	41	52							
WANEC	4											

Subroutine KNOT

```
C   SUBROUTINE 'KNOT' LOCATES THE KNOT DEFECTS ON THE BOARD FACE.
C   ANGLES ARE MEASURED CLOCKWISE WITH 0 DEGREES DEFINED AS THE
C   LINE FROM THE CENTER OF THE LOG PERPENDICULAR TO THE BOARD FACE
C
C
      SUBROUTINE KNOTC (KHIGH,KLEN,KTANG$)
C
      IMPLICIT REAL (K,L)
      INTEGER ID(22,2),NODEFC(2)
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)
      COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
     1      /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,CANT,R,BF
C
C
C   SEE IF THE KNOT IS LONG ENOUGH TO REACH THE BOARD FACE
C
      IF (KLEN.LT.DISTBD) RETURN
C
C   CALCULATE KNOT DEFECT HALF-LENGTH AS PROJECTED ON THE FACE, LOG
C   RADIUS AT KNOT HEIGHT, AND BOARD HALF-WIDTH ANGLE
C
      DY = DISTBD*TAN(RAD(KNOT$))
      LRADUS = RB-KHIGH*TAN(RAD(LOG$))
      BDWID$ = DEG(ATAN(BOARDW/DISTBD))
C
C   THE KNOT EFFECTIVELY ENDS AT THE OUTER EDGE OF THE LOG
C
      IF (KLEN.GT.LRADUS) KLEN = LRADUS
C
C   SINCE THE LOG IS TAPERED, THE OUTER BOARDS MAY NOT BE THE FULL LOG
C   LENGTH, SO KNOTS ABOVE THE END OF THE BOARD ARE NOT CONSIDERED
C
      IF (LRADUS.LT.DISTBD) RETURN
C
C   ANGLE OF ROTATION PUTS KNOT COMPLETELY OUTSIDE BOARD
C
      IF ((KTANG$.GT.180.).AND.((KTANG$+KNOT$).LT.(360.-BDWID$))) RETURN
      IF ((KTANG$.LE.180.).AND.((KTANG$-KNOT$).GT.BDWID$)) RETURN
C
C
C   FIND THE QUADRANT IN WHICH THE KNOT LIES (ASSUME QUADRANT ONE)
C
C   QUADRANT TWO
C
      IF ((KTANG$.LT.180.).AND.((KTANG$+KNOT$).GT.BDWID$)) GO TO 3
C
C   QUADRANT THREE
C
      IF ((KTANG$.GE.180.).AND.((KTANG$-KNOT$).LT.(360.-BDWID$)))
     .  GO TO 4
C
C   QUADRANT FOUR
C
      IF (KTANG$.GT.270.) GO TO 5
C
C
C   QUADRANT ONE
C
C   SEE IF KNOT CENTER IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES
C
      IF (KTANG$-KNOT$.LT.0.) GO TO 2
C
C   CALCULATE DISTANCE TO FACE ALONG BOTH SIDES OF KNOT
C
      ANGBD1 = DISTBD/COS(RAD(KTANG$-KNOT$))
      ANGBD2 = DISTBD/COS(RAD(KTANG$+KNOT$))
C
C   KNOT IS NOT LONG ENOUGH TO REACH FACE
C
      IF (KLEN.LT.ANGBD1) RETURN
C
C   FIND INTERSECTION OF NEAR SIDE OF KNOT AND FACE
C
      XR = BOARDW-DISTBD*TAN(RAD(KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD2) GO TO 1
C
C   FAR SIDE OF KNOT REACHES FACE
C
      XL = BOARDW-DISTBD*TAN(RAD(KTANG$+KNOT$))
      FULWID = (XR-XL)/2.
      GO TO 8
C
C   FAR SIDE OF KNOT DOES NOT REACH FACE
C
    1 XL = BOARDW-SQRT(KLEN**2-DISTBD**2)
      FULWID =
     .  DISTBD*TAN(RAD(KTANG$+KNOT$))-DISTBD*TAN(RAD(KTANG$-KNOT$))
      GO TO 8
C
C   KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES
C
    2 XL = AMIN1(SQRT(KLEN**2-DISTBD**2),DISTBD*TAN(RAD(KNOT$+KTANG$)))
      XL = BOARDW-XL
      XR = AMIN1(SQRT(KLEN**2-DISTBD**2),DISTBD*TAN(RAD(KNOT$-KTANG$)))
      XR = BOARDW+XR
C
C   KNOTS NEARLY PERPENDICULAR HAVE THEIR WIDTH ESTIMATED BY THEIR
C   LENGTH
C
      FULWID = DY*2.
      GO TO 8
C
C   QUADRANT TWO
C
    3 ANGBD1 = DISTBD/COS(RAD(KTANG$-KNOT$))
C
C   TOO SHORT TO REACH FACE
C
      IF (KLEN.LT.ANGBD1) RETURN
      XR = BOARDW-SQRT(ANGBD1**2-DISTBD**2)
      XL = BOARDW-SQRT(KLEN**2-DISTBD**2)
      IF ((KTANG$+KNOT$).GE.89.5)
     .  FULWID = LRADUS-DISTBD*TAN(RAD(KTANG$-KNOT$))
      IF ((KTANG$+KNOT$).LT.89.5)
     .  FULWID = AMIN1(LRADUS,DISTBD*TAN(RAD(KTANG$+KNOT$)))
     .    -DISTBD*TAN(RAD(KTANG$-KNOT$))
      GO TO 8
C
C   QUADRANT THREE
C
    4 ANGBD1 = DISTBD/COS(RAD(360.-KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD1) RETURN
      XR = BOARDW+SQRT(KLEN**2-DISTBD**2)
      XL = BOARDW+SQRT(ANGBD1**2-DISTBD**2)
      IF ((KTANG$-KNOT$).LE.270.5)
     .  FULWID = LRADUS-DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      IF ((KTANG$-KNOT$).GT.270.5)
     .  FULWID = AMIN1(LRADUS,DISTBD*TAN(RAD(360.-KTANG$+KNOT$)))
     .    -DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      GO TO 8
C
C   QUADRANT FOUR
C
    5 IF (360.-KTANG$-KNOT$.LT.0.) GO TO 7
      ANGBD1 = DISTBD/COS(RAD(360.-KTANG$-KNOT$))
      ANGBD2 = DISTBD/COS(RAD(360.-KTANG$+KNOT$))
      IF (KLEN.LT.ANGBD1) RETURN
      XL = BOARDW+DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD2) GO TO 6
C
C   FAR SIDE OF KNOT REACHES FACE
C
      XR = BOARDW+DISTBD*TAN(RAD(360.-KTANG$+KNOT$))
      FULWID = (XR-XL)/2.
      GO TO 8
C
C   FAR SIDE OF KNOT DOES NOT REACH FACE
C
    6 XR = BOARDW+SQRT(KLEN**2-DISTBD**2)
      FULWID = DISTBD*TAN(RAD(360.-KTANG$+KNOT$))
     .  -DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
      GO TO 8
C
C
```

```
154 C   KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES                  KNOTC
155 C                                                                    KNOTC
156       Z XL = AMIN1(SQRT(KLEN**2-DISTBD**2).                          KNOTC
157      .  DISTBD*TAN(PHD(KTANG$+KNOT$-360.)))                          KNOTC
158         XL = BOARDU-XL                                               KNOTC
159         XR = AMIN1(SQRT(KLEN**2-DISTBD**2).                          KNOTC
160      .  DISTBD*TAN(PAD(360.-KTANG$+KNOT$)))                          KNOTC
161         XR = BOARDU+XR                                               KNOTC
162         FULWID = D*2.                                                KNOTC
163 C                                                                    KNOTC
164 C   IF A KNOT COMPLETELY INTERSECTS THE FACE, ITS LENGTH IS EXACTLY AS KNOTC
165 C   MEASURED ON THE FACE.  OTHERWISE, ITS LENGTH IS ESTIMATED AS A   KNOTC
166 C   PROPORTION OF ITS PROJECTED LENGTH                                KNOTC
167 C                                                                    KNOTC
168       S DY = AMIN1(D,.DY*(XR-XL)*2, FULWID))                         KNOTC
169         YB = KHIGH-DY                                                KNOTC
170         YT = KHIGH+DY                                                KNOTC
171 C                                                                    KNOTC
172 C   DEFECT LOCATIONS FOUND.  CHECK THAT THEY DO NOT EXTEND BEYOND THE KNOTC
173 C   BOARD EDGES AND CONVERT TO QUARTER INCH UNITS FOR THE GRADING    KNOTC
174 C   PROGRAM                                                          KNOTC
175 C                                                                    KNOTC
176         XL = AMAX0(0.INT(XL*4.))                                     KNOTC
177         XR = AMIN0(INT(BOARDU*8.),INT(XR*4.+1.))                     KNOTC
178         YB = AMAX0(0.INT(YB*4.))                                     KNOTC
179         YT = AMIN0(INT(BDLEN*4.),INT(YT*4.+1.))                      KNOTC
180 C                                                                    KNOTC
181 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22) KNOTC
182 C                                                                    KNOTC
183         NODEFC(1) = NODEFC(1)+1                                      KNOTC
184         IF (NODEFC(1).GT.32) RETURN                                  KNOTC
185 C                                                                    KNOTC
186 C   SAVE KNOT COORDINATES FOR GRADING PROGRAM                        KNOTC
187 C                                                                    KNOTC
188         ID(NODEFC(1),1) = 3                                          KNOTC
189         FLY(NODEFC(1),1) = XL                                        KNOTC
190         FLX(NODEFC(1),1) = YB                                        KNOTC
191         FUY(NODEFC(1),1) = XR                                        KNOTC
192         FUX(NODEFC(1),1) = YT                                        KNOTC
193         RETURN                                                       KNOTC
194         END                                                          KNOTC
```

*** STATEMENT NUMBERS ***

```
    1       75   *87
    2       91   191
    3       47  *104
    4       49  *120
    5       51  *133
    6      140  *140
    7      135  *156
    0       80    87   100   116   129   144   151  *168
```

*** VARIABLES ***

```
AMAX0       175   176
AMIN0       177   179
AMIN1        31    93   113   126   156   159   168
ANGBD1      *65    70  *104   108   109  *120   121   123  *134   136
ANGBD2      *66    75  *135   138
ATAN         24
BDLEN        11   179
BNUID$      *23    37    39    45    49
BF           11
BOARDU       11    24    74    78    84    92    94   109   110   122   123   137
```

```
                142   148   158   161   177
CANT             11
COS              65    66   104   120   134   135
D                17
DEG              24
DISTBD           11    17    22    24    33    65    66    74    78    84    85    91
                 93   104   109   110   111   113   120   122   123   124   126   134
                135   137   142   148   149   156   159
DY              *22    99   162  *168   169   170
FLX              10    11  *190
FLY              10    11  *189
FULWID          *79   *85   *99  *111  *113  *124  *126  *143  *149  *162   168
FUX              10    11  *192
FUY              10    11  *191
ID                9    11  *186
INT             176   177   178   179
K                11
KHIGH             6    23   169   170
KLEN              6    17  *28    70    75    84    91    93   108   110   121   122
                136   138   148   156   159
KNOT$            11    22    37    38    45    49    61    65    66    74    78    85
                 91    93   104   111   113   120   124   126   133   134   135   137
                142   149   156   159
KNOTC             6
KTANG$            6    37    38    45    49    54    61    65    66    74    78    85
                 91    93   104   111   113   120   124   126   133   134   135   137
                142   149   156   159
L                11
LOG$             11    23
LPADUS          *23    28    33   111   113   124   126
NODEFC            9    11  *183   184   188   189   190   191   192
P                11
PAD              21    22    65    66    74    78    85    91    93   104   111   117
                120   124   126   134   135   137   142   149   156   159
PD               11    23
SQRT             84    91    93   109   110   122   123   143   156   159
T                11
TAN              22    23    74    78    85    91    93   111   113   124   126   137
                142   149   156   159
XL              *78    79   *84   *91   *92  *110  *123  *137   143  *156  *158   168
               *175   189
XP              *74    79   *93   *94  *109  *122  *142   143  *148  *159  *161   166
               *177   191
YB              *169  *178   190
YT              *170  *179   192
```

Subroutine CORE

```
 1 C   SUBROUTINE 'CORE' LOCATES THE CORE DEFECT ON THE BOARD FACE          COREC
 2 C                                                                        COREC
 3 C                                                                        COREC
 4       SUBROUTINE COREC (CRADUS,COFSET,CANG$)                             COREC
 5 C                                                                        COREC
 6       IMPLICIT REAL (K,L)                                                COREC
 7       REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                       COREC
 8       INTEGER NODEFC(2),ID(22,2)                                         COREC
 9       COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,CANT,R,BF COREC
10              /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                          COREC
11 C                                                                       COREC
12 C                                                                       COREC
13 C   FIND DISTANCE TO THE BOARD FACE FROM THE CENTER OF THE CORE. EXIT   COREC
14 C   IF THE BOARD FACE IS BEYOND THE CORE RADIUS                         COREC
15 C                                                                       COREC
16       TDIST = DISTBD-COFSET*COS(RAD(CANG$))                             COREC
17       IF (CRADUS.LE.TDIST) RETURN                                       COREC
18       NODEFC(1) = NODEFC(1)+1                                           COREC
19 C                                                                       COREC
20 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)  COREC
21 C                                                                       COREC
22       IF (NODEFC(1).GT.22) RETURN                                       COREC
23 C                                                                       COREC
24 C   LOCATE THE CENTER POINT OF THE INTERSECTION OF THE BOARD FACE AND   COREC
25 C   THE CORE DEFECT.  CALCULATE THE DISTANCE ON THE BOARD FROM THE      COREC
26 C   CENTER POINT TO THE EDGES OF THE CORE DEFECT.  THE CORE DEFECT      COREC
27 C   IS NOT TAPERED, SO IT WILL EXTEND THE FULL LENGTH OF THE BOARD      COREC
28 C                                                                       COREC
29       CONST = SQRT(CRADUS**2-TDIST**2)                                  COREC
30       TBDCTR = COFSET*SIN(RAD(CANG$))                                   COREC
31       XR = BOARDW+CONST-TBDCTR                                          COREC
32       XL = BOARDW-CONST-TBDCTR                                          COREC
33 C                                                                       COREC
34 C   SAVE CORE DEFECT COORDINATES FOR GRADING PROGRAM                    COREC
35 C                                                                       COREC
36       FUX(NODEFC(1),1) = INT(BDLEN*4.)                                  COREC
37       FLX(NODEFC(1),1) = 0.0                                            COREC
38       FUY(NODEFC(1),1) = AMIN0(INT(BOARDW*8.),INT(XR*4.+1.))            COREC
39       FLY(NODEFC(1),1) = AMAX0(0.INT(XL*4.))                            COREC
40       ID(NODEFC(1),1) = 7                                               COREC
41       RETURN                                                            COREC
42       END                                                               COREC
```

*** VARIABLES ***

```
AMAX0      39
AMIN0      38
BDLEN       9    36
BF          9
BOARDW      9    31    32    38
CANG$       4    16    38
CANT        9
COFSET      4    16    38
CONST      *29   31    32
COREC       4
COS        16
CRADUS      4    17    29
D           9
DISTBD      9    16
FLX         7     9   *37
FLY         7     9   *39
FUX         7     9   *36
FUY         7     9   *38
ID          8     9   *40
INT        36    38    39
K           9
KNOT$       9
L           9
LOG$        9
NODEFC      8     9   *18    22    36    37    38    39    40
R           9
RAD        16    30
RB          9
SIN        30
SQRT       29
T           9
TBDCTR     *30   31    32
TDIST      *16   17    29
XL         *32   39
XR         *31   38
```

U.S. Forest Products Laboratory.

Programs for computer simulation of hardwood log sawing, by W. K. Adkins, D. B. Richards, D. W. Lewis, and E. H. Bulgrin. Madison, Wis., FPL, 1980.

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Four computer programs were developed at the University of Kentucky as simulation models for investigating factors affecting sawn log values over four hardwood sawing methods: quadrant sawing, cant sawing, decision sawing, and live sawing with rerip for grade. The programs are listed along with information on the sawing methods, model assumptions, and program organization.

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Subroutine GRADE

```
 1 C   SUBROUTINE 'GRADE' CALLS THE U.S. FOREST PRODUCTS LABORATORY        GRADE
 2 C   GRADING PROGRAM                                                     GRADE
 3 C                                                                       GRADE
 4 C                                                                       GRADE
 5       SUBROUTINE GRADE (NPG)                                            GRADE
 6 C                                                                       GRADE
 7       INTEGER ID(22,2),NODEFC(2),IX(22)                                 GRADE
 8       REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                      GRADE
 9       COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                          GRADE
10 C                                                                       GRADE
11 C                                                                       GRADE
12       M = NODEFC(1)                                                     GRADE
13       IF (M.GT.22) GO TO 3                                              GRADE
14       IF (M.EQ.0) GO TO 2                                               GRADE
15       DO 1 J=1,M                                                        GRADE
16         IX(J) = ID(J,1)                                                 GRADE
17     1 CONTINUE                                                          GRADE
18     2 NPG = 1                                                           GRADE
19       CALL GRD (M,IX,NPG,SM)                                            GRADE
20       RETURN                                                            GRADE
21 C                                                                       GRADE
22 C   IF NUMBER OF DEFECTS IS MORE THAN GRADING PROGRAM CAN HANDLE,       GRADE
23 C   THE GRADE IS 3A/3B                                                  GRADE
24 C                                                                       GRADE
25     3 NPG = 5                                                           GRADE
26       WRITE (6,100)                                                     GRADE
27   100 FORMAT ('     DEFECT LIMIT EXCEEDED')                             GRADE
28       RETURN                                                            GRADE
29       END                                                               GRADE
```

*** STATEMENT NUMBERS ***

1	15	*17
2	14	*18
3	13	*25
100	26	*27

*** VARIABLES ***

FLX	8	9			
FLY	9	9			
FUX	8	9			
FUY	8	9			
GRADE	5				
GRD	19				
ID	7	9	16		
IX	7	*16	19		
J	*15	16			
M	*12	13	14	15	19
NODEFC	7	9	12		
NPG	5	*18	19	*25	
SM	19				

Subroutine PRICE

```
 1 C   SUBROUTINE 'PRICE' DETERMINES THE BOARD GRADE BASED ON THE GRADES   PRICEC
 2 C   OF BOTH SIDES (OLD,NPG) AND CALCULATES THE BOARD VALUE               PRICEC
 3 C                                                                       PRICEC
 4 C                                                                       PRICEC
 5       SUBROUTINE PRICEC (OLD,NPG,TVAL,PERC)                             PRICEC
 6 C                                                                       PRICEC
 7       IMPLICIT REAL (K,L)                                               PRICEC
 8       INTEGER OLD                                                       PRICEC
 9       REAL PERC(5)                                                      PRICEC
10       COMMON /PRICE/ FAS,SEL,ONEC,TWOC,THRB                             PRICEC
11              /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,CANT,R,BF PRICEC
12 C                                                                       PRICEC
13 C                                                                       PRICEC
14 C   DETERMINE THE BOARD GRADE                                           PRICEC
15 C                                                                       PRICEC
16       IF (OLD.EQ.5.OR.NPG.EQ.5) GO TO 3                                 PRICEC
17       IF (OLD.EQ.2.OR.NPG.EQ.2) GO TO 1                                 PRICEC
18       IF (OLD.EQ.NPG) GO TO 4                                           PRICEC
19       NPG = MAX0(OLD,NPG)                                               PRICEC
20       IF (NPG.EQ.4) GO TO 8                                             PRICEC
21       NPG = 2                                                           PRICEC
22       GO TO 4                                                           PRICEC
23     1 IF (OLD.EQ.4.OR.NPG.EQ.4) GO TO 2                                 PRICEC
24       NPG = 3                                                           PRICEC
25       GO TO 4                                                           PRICEC
26     2 NPG = 4                                                           PRICEC
27       GO TO 4                                                           PRICEC
28     3 NPG = 5                                                           PRICEC
29 C                                                                       PRICEC
30 C   AND CALCULATE THE BOARD VALUE                                       PRICEC
31 C                                                                       PRICEC
32     4 GO TO (5,6,7,8,9), NPG                                            PRICEC
33     5 V = BF*FAS                                                        PRICEC
34       GO TO 10                                                          PRICEC
35     6 V = BF*SEL                                                        PRICEC
36       GO TO 10                                                          PRICEC
37     7 V = BF*ONEC                                                       PRICEC
38       GO TO 10                                                          PRICEC
39     8 V = BF*TWOC                                                       PRICEC
40       GO TO 10                                                          PRICEC
41     9 V = BF*THRB                                                       PRICEC
42 C                                                                       PRICEC
43 C   INCREASE SURFACE MEASURE IN THIS GRADE AND THE TOTAL LOG VALUE      PRICEC
44 C                                                                       PRICEC
45    10 PERC(NPG) = BF+PERC(NPG)                                          PRICEC
46       TVAL = TVAL+V                                                     PRICEC
47       RETURN                                                            PRICEC
48       END                                                               PRICEC
```

*** STATEMENT NUMBERS ***

1	17	*23				
2	23	*26				
3	16	*28				
4	18	22	25	27	*32	
5	32	*33				
6	32	*35				
7	32	*37				
8	20	32	*39			
9	32	*41				
10	34	36	38	40	*45	

*** VARIABLES ***

BDLEN	10											
BF	10	33	35	37	39	41	45					
BOARDU	10											
CANT	10											
D	10											
DISTBD	10											
FAS	10	33										
K	10											
KNOTS	10											
L	10											
LOGS	10											
MAXB	19											
NPG	5	16	17	18	*19	20	*21	23	*24	*26	*28	32
	45											
OLD	5	8	16	17	18	19	23					
ONEC	10	37										
PERC	5	9	*45									
PRICEC	5											
R	10											
RB	10											
SEL	10	35										
T	10											
THRB	10	41										
TVAL	5	*46										
TUDC	10	39										
V	*10	*35	*37	*39	*41	46						

Function DEG

```
1 C   FUNCTION 'DEG' CONVERTS ITS ARGUMENT (IN RADIANS) TO DEGREES          DEG
2 C                                                                        DEG
3 C                                                                        DEG
4       FUNCTION DEG(A)                                                    DEG
5 C                                                                        DEG
6 C                                                                        DEG
7       DEG = A*180.0/3.141592                                             DEG
8       RETURN                                                             DEG
9       END                                                                DEG
```

*** VARIABLES ***

A	4	7
DEG	4	*7

Function RAD

```
 1 C   FUNCTION 'RAD' CONVERTS ITS ARGUMENT (IN DEGREES) TO RADIANS          RAD
 2 C                                                                         RAD
 3 C                                                                         RAD
 4       FUNCTION RAD(A)                                                     RAD
 5 C                                                                         RAD
 6 C                                                                         RAD
 7       RAD = A*3.141592/180.0                                              RAD
 8       RETURN                                                              RAD
 9       END                                                                 RAD
```

*** VARIABLES ***

```
A             4    7
RAD           4   *7
```

Decision Sawing (DECID)

```
C   'DECID' SIMULATES THE DECISIONS OF A SKILLED HUMAN SAWYER.  AFTER
C   THE LOG IS SQUARED AT MID-LENGTH, BOARDS ARE CUT FROM THE 'BEST'
C   FACE UNTIL A DROP IN GRADE OCCURS.  A NEW 'BEST' FACE IS THEN FOUND
C   AND THE PROCESS REPEATED FOR THE REST OF THE LOG
C
C
      IMPLICIT REAL (K,L)
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),PERC(5),BOARDW(2),
     .     DISTBD(4),SMF(4),RCUT(4),ANGLE(40),HEIGHT(40),KTLEN(40),
     .     R(4),DAT*8
      INTEGER ID(22,2),NODEFC(2),CMPLET(4),F,GDORDR(50),COUENS(50),
     .        GRDCOM(4),GDBEST,IX(22),OLD
      COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,RCUT,BF
     .       /PRICE/ FAS,SEL,ONEC,TWOC,THRB
     .       /DECID/ CMPLET,GDBEST,GRDCOM,SMBEST,SMF
     .       /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
C
C
C   THIS PROGRAM ASSUMES INPUT FROM UNIT 5 AND OUTPUTS TO UNITS 6 AND 8
C
C   GET LOG DIAMETER (IN.), LOG LENGTH (IN.), KERF SIZE (IN.), AND
C   BOARD THICKNESS (IN.)
C
    1 READ (5,116,END = 23) D
      READ (5,116) L
      READ (5,117) K
      READ (5,116) T
C
C   GET KNOT HALF-ANGLE (DEGREES) AND LOG HALF-TAPER (DEGREES)
C
      READ (5,116) KNOT$
      READ (5,116) LOG$
C
C   GET CORE DEFECT PARAMETERS: DIAMETER (IN.), LINEAR OFFSET (IN.),
C   AND ANGULAR OFFSET (DEGREES)
C
      READ (5,100) CORDIA
      READ (5,100) COFSET
      READ (5,100) CANG$
C
C   GET PRICE PER BOARD FOOT FOR EACH GRADE: NUMBER OF KNOTS
C
      READ (5,123) FAS,SEL,ONEC,TWOC,THRB
      READ (5,109) MAX
C
C   GET DATE AND CALCULATE RADIUS OF CORE DEFECT
C
      CALL DATE (DAT)
      CRADUS = CORDIA/2.
C
C   GET KNOT ANGLES, HEIGHTS, AND LENGTHS
C
      DO 2 J=1,MAX
        READ (5,102) ANGLE(J),HEIGHT(J)
    2 CONTINUE
      DO 3 J=1,MAX
        READ (5,100) KTLEN(J)
    3 CONTINUE
C
C   CALCULATE LOG RADIUS AT TOP AND BOTTOM; TOTAL LOG CUBIC FEET
C
      RI = D/2.
      RB = RI+L*TAN(RAD(LOG$))
      LVOL = 1/3.*3.141593*(RB**2+RB*RI+RI**2)*L/144.
C
C   OUTPUT HEADER
C
      WRITE (6,118) DAT
      WRITE (6,119) L,D,LOG$,LVOL
      WRITE (6,108) MAX
      DO 4 J=1,MAX
        WRITE (6,101) ANGLE(J),HEIGHT(J),KTLEN(J)
    4 CONTINUE
      WRITE (6,120) KNOT$
      WRITE (6,115) CRADUS,COFSET,CANG$
      WRITE (6,121) K,T
      WRITE (6,122) FAS,SEL,ONEC,TWOC,THRB
      WRITE (8,200) L,D,MAX,CRADUS,COFSET,CANG$,LVOL,K,T,KNOT$,LOG$
      WRITE (8,201) (KTLEN(J),J=1,MAX)
      WRITE (8,201) (HEIGHT(J),J=1,MAX)
      WRITE (8,201) (ANGLE(J),J=1,MAX)
      WRITE (8,202) FAS,SEL,ONEC,TWOC,THRB
C
C   INITIALIZE VARIABLES FOR CALCULATING HIGH, LOW, AND AVERAGE
C   YIELDS FOR EACH LOG
C
      HIGH$ = 0.
      SMALL$ = 999.
      AVG$ = 0.
      HITOT = 0.
      SMTOT = 999.
      AVTOTS = 0.
C
C   SAW LOG IN 12 DIFFERENT ROTATIONAL POSITIONS, 15 DEGREES APART, TO
C   DETERMINE THE ORIENTATION GIVING THE HIGHEST YIELD
C
      DO 22 INX=1,12
C
C   INITIALIZE FOR EACH POSITION
C
        ISQUAR = 1
C
C   INITIALIZE PORTION OF LOG TO BE CUT...  THIS SETS THE DEPTH OF
C   THE FIRST CUT ON EACH OF THE FOUR FACES OF THE LOG.  THE LOG IS CUT
C   FROM THE OUTSIDE IN AND THE SLAB FACES MAY BE CUT TO THE CENTER
C   CANT WHICH CONTAINS EXACTLY FOUR BOARDS
C
        RTBCUT = RB-2.*T-1.5*K
        NBRDS = INT(RTBCUT/(T+K))
        EXCESS = RTBCUT-NBRDS*(T+K)
        RTBCUT = RTBCUT-EXCESS
        R(1) = RTBCUT+EXCESS-T-K
        R(2) = RTBCUT+2.*T+1.5*K+EXCESS
        R(3) = R(1)
        R(4) = R(2)
        DO 5 J=1,4
          DISTBD(J) = RB
          RCUT(J) = EXCESS-T-K
          GRDCOM(J) = 0
          SMF(J) = 0.0
          CMPLET(J) = 0
    5   CONTINUE
        SMBEST =  0.0
        BF = 0.0
        TVAL = 0.0
        GDBEST = 0
        NBD = 0
        DO 6 J=1,5
          PERC(J) = 0.0
    6   CONTINUE
        F = 0
C
C   CUT FACES SEQUENTIALLY UNTIL LOG IS SQUARED AT MID-LENGTH
C
    7   F = F+1
        IF (F.EQ.5) F = 1
C
C   CUT A BOARD FROM THIS FACE.  IF THE FACE IS COMPLETELY CUT, PICK
C   A NEW FACE TO CUT
C
    8   CALL KERFD (&18,ISQUAR,F,0)
        NBD = NBD+1
C
C   FOR BOTH SIDES OF THE BOARD...
C
        DO 12 I=1,2
C
C   INITIALIZE DEFECT ARRAYS, EXCEPT F..(26,1), WHICH HOLDS THE BOARD
C   DIMENSIONS
```

```
      DO 9 J=1,25                                                       DECID
        FLX(J,1) = -9999.0                                              DECID
        FUX(J,1) = -9999.0                                              DECID
        FLY(J,1) = -9999.0                                              DECID
        FUY(J,1) = -9999.0                                              DECID
    9 CONTINUE                                                          DECID
      DO 10 J=1,22                                                      DECID
        ID(J,1) = 0                                                     DECID
   10 CONTINUE                                                          DECID
      NODEFC(1) = 0                                                     DECID
C                                                                       DECID
C PUT IN WANE DEFECTS                                                   DECID
C                                                                       DECID
      CALL WANED (F)                                                    DECID
C                                                                       DECID
C PUT IN KNOTS                                                          DECID
C                                                                       DECID
      DO 11 J=1,MAX                                                     DECID
        CALL KNOTD (HEIGHT(J),ANGLE(J),KTLEN(J),F)                      DECID
   11 CONTINUE                                                          DECID
C                                                                       DECID
C PUT IN CORE DEFECT                                                    DECID
C                                                                       DECID
      CALL CORED (CRADUS,COFSET,CANG$,F)                                DECID
C                                                                       DECID
C AND GRADE THE FACE                                                    DECID
C                                                                       DECID
      CALL GRADE (NPG)                                                  DECID
C                                                                       DECID
C SAVE GRADE OF FIRST SIDE OF BOARD                                     DECID
C                                                                       DECID
      IF (F.EQ.1) OLD = NPG                                             DECID
C                                                                       DECID
C SUBTRACT BOARD THICKNESS AND PROCESS THE INNER FACE                   DECID
C                                                                       DECID
      DISTBD(F) = DISTBD(F)-T                                           DECID
   12 CONTINUE                                                          DECID
C                                                                       DECID
C IGNORE THE LAST BOARD TAKEN                                           DECID
C                                                                       DECID
      DISTBD(F) = DISTBD(F)+T                                           DECID
C                                                                       DECID
C DETERMINE BOARD GRADE AND VALUE BASED ON GRADES OF BOTH FACES         DECID
C                                                                       DECID
      CALL PRICED (OLD,NPG,TVAL,PERC)                                   DECID
C                                                                       DECID
C SAVE BOARD GRADE AND SURFACE MEASURE                                  DECID
C                                                                       DECID
      GRDCOM(F) = NPG                                                   DECID
      SMF(F) = BF                                                       DECID
C                                                                       DECID
C SAVE SEQUENCE OF FACES CUT AND THEIR GRADES                           DECID
C                                                                       DECID
      COUNS(NBD) = F                                                    DECID
      GNORD(NBD) = NPG                                                  DECID
C                                                                       DECID
C SEE IF LOG HAS BEEN SQUARED AT MID-LENGTH                             DECID
C                                                                       DECID
      IF (ISQUAR.NE.0) GO TO 7                                          DECID
C                                                                       DECID
C ONCE THE LOG HAS BEEN SQUARED, BOARDS ARE CUT FROM THE 'BEST' FACE    DECID
C UNTIL A DROP IN GRADE OCCURS.  AFTER REGRADING THE AFFECTED FACES,    DECID
C A NEW 'BEST' FACE IS FOUND.  NOTE THAT THE 'BEST' FACE IS INITIALLY   DECID
C BETTER THAN FAS, FORCING A GRADE DROP ON THE FIRST BOARD              DECID
C                                                                       DECID
      IF (GRDCOM(F).GT.GDBEST) GO TO 13                                 DECID
C                                                                       DECID
C OTHERWISE, SAVE BOARD GRADE AND SURFACE MEASURE AND CONTINUE CUTTING  DECID
C ON THE SAME FACE                                                      DECID
C                                                                       DECID
      GDBEST = GRDCOM(F)                                                DECID
      SMBEST = SMF(F)                                                   DECID
      GO TO 8                                                           DECID
C                                                                       DECID
C REGRADE THE AFFECTED FACES. I.E., THE ONE JUST CUT AND THE ONES ON    DECID
C EITHER SIDE OF IT                                                     DECID
C                                                                       DECID
   13 F = F-2                                                           DECID
      IF (F.EQ.-1) F = 3                                                DECID
      IF (F.EQ.0) F = 4                                                 DECID
      DO 17 II=1,3                                                      DECID
        F = F+1                                                         DECID
        IF (F.EQ.5) F = 1                                               DECID
C                                                                       DECID
C INITIALIZE DEFECT ARRAYS                                              DECID
C                                                                       DECID
        DO 14 JJ=1,26                                                   DECID
          FUX(JJ,1) = -9999.0                                           DECID
          FLX(JJ,1) = -9999.0                                           DECID
          FUY(JJ,1) = -9999.0                                           DECID
          FLY(JJ,1) = -9999.0                                           DECID
   14   CONTINUE                                                        DECID
        DO 15 JJ=1,22                                                   DECID
          ID(JJ,1) = 0                                                  DECID
   15   CONTINUE                                                        DECID
        NODEFC(1) = 0                                                   DECID
C                                                                       DECID
C FIND EACH AFFECTED FACE                                               DECID
C                                                                       DECID
        CALL KERFD (&17,ISQUAR,F,1)                                     DECID
C                                                                       DECID
C PUT IN WANE                                                           DECID
C                                                                       DECID
        CALL WANED (F)                                                  DECID
C                                                                       DECID
C PUT IN KNOTS                                                          DECID
C                                                                       DECID
        DO 16 J=1,MAX                                                   DECID
          CALL KNOTD (HEIGHT(J),ANGLE(J),KTLEN(J),F)                    DECID
   16   CONTINUE                                                        DECID
C                                                                       DECID
C PUT IN CORE DEFECT                                                    DECID
C                                                                       DECID
        CALL CORED (CRADUS,COFSET,CANG$,F)                              DECID
C                                                                       DECID
C AND GRADE THE FACE                                                    DECID
C                                                                       DECID
        CALL GRADE (NPG)                                                DECID
C                                                                       DECID
C SAVE THE GRADE AND SURFACE MEASURE OF EACH AFFECTED FACE              DECID
C                                                                       DECID
        GRDCOM(F) = NPG                                                 DECID
        SMF(F) = BF                                                     DECID
C                                                                       DECID
C IGNORE THE CUT JUST TAKEN                                             DECID
C                                                                       DECID
        RCUT(F) = RCUT(F)-T-K                                           DECID
        DISTBD(F) = DISTBD(F)+K                                         DECID
   17   CONTINUE                                                        DECID
C                                                                       DECID
C RETURN TO THE FACE ORIGINALLY BEING CUT                               DECID
C                                                                       DECID
      F = F-1                                                           DECID
      IF (F.EQ.0) F = 4                                                 DECID
C                                                                       DECID
C DECIDE WHICH FACE TO CUT NEXT                                         DECID
C                                                                       DECID
   18 CALL DECIDE (F,&19)                                               DECID
      GO TO 8                                                           DECID
C                                                                       DECID
C PRINT RESULTS FOR THIS POSITION                                       DECID
C                                                                       DECID
   19 IROTAT = INX*15-15                                                DECID
      WRITE (6,111) IROTAT                                              DECID
      WRITE (6,113) (PERC(J),J=1,5)                                     DECID
      TOTS = PERC(1)+PERC(2)+PERC(3)+PERC(4)+PERC(5)                    DECID
      WRITE (6,112) TOTS                                                DECID
      WRITE (8,203) IROTAT                                              DECID
      WRITE (8,204) (PERC(J),J=1,5)                                     DECID
      WRITE (8,204) TOTS                                                DECID
      DO 20 J=1,5                                                       DECID
        PERC(J) = (PERC(J)/LVOL)*100.                                   DECID
   20 CONTINUE                                                          DECID
      TOTS = (TOTS/LVOL)*100.                                           DECID
      WRITE (6,114) TOTS                                                DECID
      WRITE (6,103) (ANGLE(J),J=1,MAX)                                  DECID
```

```
      WRITE (6,104) (PERC(J),J=1,5),TVAL
      WRITE (6,110)
      WRITE (6,107) (COUENS(J),J=1,NBD)
      WRITE (6,107) (GDORDR(J),J=1,NBD)
      WRITE (8,205) (PERC(J),J=1,5)
      WRITE (8,204) TVAL,TOTS
C
C  SAVE HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG
C
      AVTOTS = AVTOTS+TOTS
      AVG$ = AVG$+TVAL
      IF (TVAL.GT.HIGH$) HITOT = TOTS
      IF (TVAL.LT.SMALL$) SMTOT = TOTS
      IF (TVAL.GT.HIGH$) HIGH$ = TVAL
      IF (TVAL.LT.SMALL$) SMALL$ = TVAL
C
C  ROTATE LOG BY 15 DEGREES AND REPROCESS
C
      DO 21 J=1,MAX
        ANGLE(J) = AMOD(ANGLE(J)+15.0,360.0)
   21 CONTINUE
      CANG$ = AMOD(CANG$+15.,360.)
   22 CONTINUE
C
C  PRINT HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG
C
      AVTOTS = AVTOTS/12.
      AVG$ = AVG$/12.
      WRITE (6,105) HIGH$,AVG$,SMALL$
      WRITE (6,106) HITOT,AVTOTS,SMTOT
C
C  LOG COMPLETELY PROCESSED. READ PARAMETERS FOR NEXT LOG
C
      GO TO 1
C
   23 STOP
C
C  FORMATS FOR DEVICE 6 (PRINTER)
C
  100 FORMAT (F6.3)
  101 FORMAT (3(2X,F6.2))
  102 FORMAT (2F6.2)
  103 FORMAT (' KNOT ANGLES: ',15F7.2,/,13X,15F7.2)
  104 FORMAT (' % OF AVAILABLE SURFACE MEASURE IN EACH GRADE: ',5F5.1,
     .  ' LOG VALUE IS $',F6.2)
  105 FORMAT (' $ YIELD:  HIGH ',F6.2,'  AVERAGE ',F6.2,'  LOW ',F6.2)
  106 FORMAT (' % YIELD:  HIGH $ FACE ',F6.2,'  AVERAGE ',F6.2,
     .  '  LOW $ FACE ',F6.2)
  107 FORMAT (' ',40I3)
  108 FORMAT ('1THERE ARE',I3,'KNOTS IN THIS LOG. THEY ARE'/
     .  4X,'ANGLE  HEIGHT  LENGTH')
  109 FORMAT (I2)
  110 FORMAT (' SEQUENCE OF LOG FACES CUT AND THEIR BOARD GRADES')
  111 FORMAT ('2(/),' ROTATION IS',I4)
  112 FORMAT (' TOTAL SURFACE MEASURE IS',F8.2)
  113 FORMAT (' SURFACE MEASURE PER GRADE IS',5F7.2)
  114 FORMAT (' TOTAL PERCENT YIELD IS',F8.2)
  115 FORMAT (' CORE DEFECT RADIUS ',F6.3,'  LINEAR OFFSET ',F6.3,
     .  '  ANGULAR OFFSET ',F6.3)
  116 FORMAT (F5.1)
  117 FORMAT (F5.3)
  118 FORMAT (' DECISION SAWING METHOD ',A8)
  119 FORMAT (' LOG PARAMETERS:  LENGTH',F6.1,'  DIA',F6.1,'  TAPER',
     .  F6.4,' DEGREES.  LOG VOLUME: ',F8.2,' CUBIC FEET')
  120 FORMAT (' ANGLES MEASURED FROM ZERO DEGREES = EAST FOR A ',
     .  'VERTICALLY CUTTING SAW.  KNOT TAPER',F6.2)
  121 FORMAT (' CUTTING PARAMETERS:  KERF',F6.4,'  BOARD THICKNESS'
     .  F5.2)
  122 FORMAT (' PRICES PER BOARD FOOT: ',5F10.4)
  123 FORMAT (5F10.4)
C
C  FORMATS FOR DEVICE 8 (STORAGE MEDIUM)
C
  200 FORMAT (F6.1,F5.1,I3,3F5.1,F8.2,F6.3,F4.1,F6.2,F5.3,F6.3)
  201 FORMAT (3(10F7.2/))
  202 FORMAT (5F7.4)
  203 FORMAT (I3)
  204 FORMAT (5F8.2)
  205 FORMAT (10F6.2)
      END
```

*** STATEMENT NUMBERS ***

1	*24	340					
2	53	*55					
3	56	*58					
4	71	*73					
5	116	*122					
6	128	*130					
7	*135	200					
8	*141	223	289				
9	151	*156					
10	157	*159					
11	168	*170					
12	146	*187					
13	216	*228					
14	237	*242					
15	243	*245					
16	258	*260					
17	231	250	*279				
18	141	*288					
19	288	*293					
20	301	*303					
21	325	*327					
22	97	*329					
23	24	*342					
100	37	38	39	57	*346		
101	72	*347					
102	54	*348					
103	306	*349					
104	307	*350					
105	335	*352					
106	336	*353					
107	309	310	*355				
108	70	*356					
109	44	*358					
110	308	*359					
111	294	*360					
112	297	*361					
113	295	*362					
114	305	*363					
115	75	*364					
116	24	25	27	31	32	*366	
117	26	*367					
118	68	*368					
119	69	*369					
120	74	*371					
121	76	*373					
122	77	*375					
123	43	*376					
200	78	*380					
201	79	80	81	*381			
202	82	*382					
203	298	*383					
204	299	300	312	*384			
205	311	*385					

*** VARIABLES ***

AMOD	326	328						
ANGLE	8	*54	72	81	169	259	306	*326
AVG$	*89	*317	*334	335				
AVTOTS	*92	*316	*333	336				

Subroutine KERF

```
      SUBROUTINE 'KERF' CUTS A BOARD FROM THE LOG.  THE BOARD WIDTH IS   KERFD
      DEFINED AT THE CENTER, AND THE BOARD LENGTH FROM THE BOTTOM        KERFD
      OF THE LOG                                                         KERFD
                                                                         KERFD
                                                                         KERFD
        SUBROUTINE KERFD (*,ISQUAR,F,IREGRD)                             KERFD
                                                                         KERFD
        IMPLICIT REAL (K,L)                                              KERFD
        INTEGER F,FRT,FLFT,ID(22,2),CMPLET(4),NODEFC(2),GRDCOM(4)        KERFD
        REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),BOARDW(2),WT(2),    KERFD
       .     DISTBD(4),RCUT(4),SMF(4),R(4)                               KERFD
        COMMON /BOARD/ L,D,K,T,LOGS,RB,DISTBD,BDLEN,BOARDW,KNOTS,R,RCUT,BF KERFD
       .       /DECID/ CMPLET,GDBEST,GRDCOM,SMBEST,SMF                   KERFD
       .       /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                         KERFD
                                                                         KERFD
                                                                         KERFD
      ALL BOARDS MUST BE AT LEAST 48 INCHES LONG, 2.5 INCHES WIDE AT     KERFD
      THE TOP, AND 3 INCHES WIDE AT THE CENTER.  IN ADDITION, THE TOTAL  KERFD
      AMOUNT OF WANE FROM THE CENTER TO THE TOP IS LIMITED TO 4 INCHES.  KERFD
      THE BOARD IS CUT BACK IN ONE FOOT INCREMENTS IF THE WIDTH OR WANE  KERFD
      TESTS FAIL.  IF THE LENGTH TEST FAILS, ANOTHER BOARD IS CUT FROM   KERFD
      THIS FACE                                                          KERFD
                                                                         KERFD
        RI = D/2.                                                        KERFD
                                                                         KERFD
      FIND THE TWO ADJACENT FACES                                        KERFD
                                                                         KERFD
        FLFT = F-1                                                       KERFD
        IF (FLFT.EQ.0) FLFT = 4                                          KERFD
        FRT = F+1                                                        KERFD
        IF (FRT.EQ.5) FRT = 1                                            KERFD
                                                                         KERFD
      FIND OUTER FACE OF BOARD                                           KERFD
                                                                         KERFD
    1   RCUT(F) = RCUT(F)+T+K                                            KERFD
        DISTBD(F) = RB-RCUT(F)                                           KERFD
        BDLEN = L                                                        KERFD
                                                                         KERFD
      IF THIS FACE OF THE LOG IS COMPLETELY CUT, EXIT                    KERFD
                                                                         KERFD
        IF (RCUT(F).GT.R(F)) GO TO 6                                     KERFD
        POSLEN = RCUT(F)*TAN(RAD(90.-LOGS))                              KERFD
                                                                         KERFD
      CHECK FOR BOARDS SHORTER THAN THE LOG DUE TO LOG TAPER             KERFD
                                                                         KERFD
        IF (POSLEN.LT.BDLEN) BDLEN = POSLEN                              KERFD
                                                                         KERFD
      BOARDS MUST BE AT LEAST 4 FEET LONG                                KERFD
                                                                         KERFD
    2   IF (BDLEN.LT.48.) GO TO 5                                        KERFD
                                                                         KERFD
      DETERMINE HALF-WIDTHS AT MID-LENGTH OF BOARD.  SINCE THE BOARD IS  KERFD
      NOT NECESSARILY SYMMETRICAL ABOUT A LINE FROM THE CENTER OF THE    KERFD
      LOG PERPENDICULAR TO THE BOARD FACE, THE WIDTH OF EACH SIDE MUST   KERFD
      BE DETERMINED SEPARATELY                                           KERFD
                                                                         KERFD
        RM = RI+(L-BDLEN/2.)*TAN(RAD(LOGS))                              KERFD
        IF (DISTBD(F).GT.RM) GO TO 4                                     KERFD
        BOARDW(1) = SQRT(RM**2-DISTBD(F)**2)                             KERFD
        BOARDW(2) = BOARDW(1)                                            KERFD
                                                                         KERFD
      THE BOARD WIDTH MAY BE LIMITED BY THE ADJACENT FACES               KERFD
                                                                         KERFD
        DSTLFT = DISTBD(FLFT)-K                                          KERFD
        DSTRGT = DISTBD(FRT)-K                                           KERFD
        BOARDW(1) = AMIN1(DSTLFT,BOARDW(1))                              KERFD
        BOARDW(2) = AMIN1(DSTRGT,BOARDW(2))                              KERFD
                                                                         KERFD
      IS LOG SQUARED AT MID-LENGTH?                                      KERFD
                                                                         KERFD
        IF (BOARDW(2).EQ.DSTRGT) ISQUAR = 0                              KERFD
                                                                         KERFD
      BOARD MUST BE AT LEAST 3 INCHES WIDE AT MID-LENGTH                 KERFD
                                                                         KERFD
        IF ((BOARDW(1)+BOARDW(2)).LT.3.) GO TO 4                         KERFD

      DETERMINE HALF-WIDTHS AT TOP OF BOARD                              KERFD
                                                                         KERFD
        RT = RI+(L-BDLEN)*TAN(RAD(LOGS))                                 KERFD
        IF (DISTBD(F).GT.RT) GO TO 4                                     KERFD
        WT(1) = SQRT(RT**2-DISTBD(F)**2)                                 KERFD
        WT(2) = WT(1)                                                    KERFD
        WT(1) = AMIN1(DSTLFT,WT(1))                                      KERFD
        WT(2) = AMIN1(DSTRGT,WT(2))                                      KERFD
                                                                         KERFD
      BOARD MUST BE AT LEAST 2.5 INCHES WIDE AT THE TOP                  KERFD
                                                                         KERFD
        IF ((WT(1)+WT(2)).LT.2.5) GO TO 4                                KERFD
                                                                         KERFD
      LIMIT THE TOTAL WANE TO AVOID GENERATING MORE DEFECTS THAN THE     KERFD
      GRADING PROGRAM CAN HANDLE.  TOTAL WIDTH OF WANE MUST BE LESS      KERFD
      THAN 4 INCHES                                                      KERFD
                                                                         KERFD
        WAN = BOARDW(1)+BOARDW(2)-WT(1)-WT(2)                            KERFD
        IF (WAN.GT.4.) GO TO 4                                           KERFD
                                                                         KERFD
      CONVERT BOARD HALF-WIDTHS AND LENGTH TO EVEN QUARTER INCHES        KERFD
                                                                         KERFD
        DO 3 J=1,2                                                       KERFD
          BOARDW(J) = INT(BOARDW(J)*4.)/4.                               KERFD
    3   CONTINUE                                                         KERFD
        BDLEN = INT(BDLEN*4.)/4.                                         KERFD
                                                                         KERFD
      DEFINE BOARD EDGES IN QUARTER INCH UNITS                           KERFD
                                                                         KERFD
        FLX(26,1) = BDLEN*4.                                             KERFD
        FUX(26,1) =  0.0                                                 KERFD
        FLY(26,1) = (BOARDW(1)+BOARDW(2))*4.                             KERFD
        FUY(26,1) =  0.0                                                 KERFD
                                                                         KERFD
      CALCULATE UNROUNDED BOARD FEET                                     KERFD
                                                                         KERFD
        BF = BDLEN*(BOARDW(1)+BOARDW(2))*T/144.                          KERFD
        RETURN                                                           KERFD
                                                                         KERFD
      CUT BACK BOARD BY ONE FOOT                                         KERFD
                                                                         KERFD
    4   BDLEN = BDLEN-12.                                                KERFD
        GO TO 2                                                          KERFD
                                                                         KERFD
      IF THE LOG IS BEING REGRADED, ANOTHER BOARD SHOULD NOT BE CUT      KERFD
      FROM THIS FACE                                                     KERFD
                                                                         KERFD
    5   IF (IREGRD.EQ.1) GO TO 6                                         KERFD
        GO TO 1                                                          KERFD
                                                                         KERFD
      FACE HAS BEEN COMPLETELY CUT.  DO NOT CUT ANY MORE BOARDS FROM IT  KERFD
                                                                         KERFD
    6   CMPLET(F) = 1                                                    KERFD
        GRDCOM(F) = 7                                                    KERFD
                                                                         KERFD
      IGNORE THE CUT JUST ATTEMPTED                                      KERFD
                                                                         KERFD
        RCUT(F) = RCUT(F)-T-K                                            KERFD
        DISTBD(F) = RB-RCUT(F)+T                                         KERFD
        SMF(F) = 0.0                                                     KERFD
        RETURN1                                                          KERFD
        END                                                              KERFD
```

*** STATEMENT NUMBERS ***

1	*35	124
2	*50	118
3	98	*100

```
     4      50    75    79    87    94  *117
     5      50  *123
     6      41   123  *128


                              ***  VARIABLES  ***

AMIN1         66    67    82    83
BDLEN         12   *37   *46    50    57    78  *101   105   112  *117
BF            12  *112
BOARDW        10    12   *59   *60   *66   *67    71    75    93   *99   107   112
CMPLET         9    12  *128
D             12    24
DISTBD        10    12   *36    50    59    64    65    79    80  *134
DSTLFT       *64    66    82
DSTRGT       *65    67    71    83
F             6     9    28    38    35    36    41    42    58    59    79    80
             128   129   133   134   135
FLFT           9   *28   *29    64
FLX           10    12  *105
FLY           10    12  *107
FRT            9   *30   *31    65
FUX           10    12  *106
FUY           10    12  *108
GDBEST        12
GRDCOM         9    12  *129
ID             9    12
INT           99   101
IREGRD         6   123
ISQUAR         6   *71
J            *98    99
K             12    35    64    65   133
KERFD          6
KNOTS         12
L             12    37    57    78
LOGS          12    42    57    78
NODEFC         9    12
POSLEN       *42    46
R             10    12    41
RAD           42    57    78
RB            12    36   134
RCUT          10    12   *35    36    41    42  *133   134
RI           *24    57    78
RM           *57    58    59
RT           *78    79    80
SMBEST        12
SMF           10    12  *135
SQRT          59    90
T             12    35   112   133   134
TAN           42    57    78
WAN          *93    94
WT            10   *80   *81   *82   *83    87    93
```


Subroutine WANE

```
 1 C   SUBROUTINE 'WANE' LOCATES WANE DEFECTS ON THE BOARD                    WANED
 2 C                                                                         WANED
 3 C                                                                         WANED
 4       SUBROUTINE WANED (F)                                                WANED
 5 C                                                                         WANED
 6 C   THE BOARD EDGE HAS A NEW WANE DEFECT IF THE HALF-WIDTH ON THAT SIDE   WANED
 7 C   DROPS BY 1/4 INCH.  SINCE THE BOARD IS NOT NECESSARILY SYMMETRICAL    WANED
 8 C   THE WIDTH OF THE WANE DEFECTS MUST BE CALCULATED SEPARATELY FOR EACH  WANED
 9 C   SIDE                                                                  WANED
10 C                                                                         WANED
11        IMPLICIT REAL (K,L)                                               WANED
12        INTEGER ID(22,2),NODEFC(2),F                                      WANED
13        REAL BOARDW(2),DISTBD(4),FLY(26,2),FLX(26,2),FUY(26,2),FUX(26,2), WANED
14       .     RCUT(4),R(4)                                                 WANED
15        COMMON /BOARD/ L,D,K,T,LOGS,RB,DISTBD,BDLEN,BOARDW,KNOTS,R,RCUT,BF WANED
16       .       /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                         WANED
17 C                                                                         WANED
18 C                                                                         WANED
19        CON1 = TAN(RAD(LOGS))                                             WANED
20        CON2 = DISTBD(F)**2                                               WANED
21        IF ((RB-SQRT(CON2+BOARDW(2)**2))/CON1.GE.BDLEN) GO TO 3           WANED
22        OLDH = BDLEN*2.                                                   WANED
23        V = 0.                                                            WANED
24 C                                                                         WANED
25 C                                                                         WANED
26 C   FIND THE PLACE ALONG THE BOARD WHERE THE HALF-WIDTH HAS DECREASED     WANED
27 C   BY 1/4 INCH.  THE DEFECT ENDS HERE AND EXTENDS FROM THE END OF THE    WANED
28 C   LAST WANE DEFECT (OR FROM THE MIDDLE OF THE BOARD)                    WANED
29 C                                                                         WANED
30      1 V = V+0.25                                                        WANED
31        SQR = SQRT(CON2+(BOARDW(2)-V)**2)                                 WANED
32        H = INT(AMIN1((RB-SQR)*4./CON1.BDLEN*4.))                         WANED
33        NODEFC(1) = NODEFC(1)+1                                           WANED
34        M = NODEFC(1)                                                     WANED
35 C                                                                         WANED
36 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)    WANED
37 C                                                                         WANED
38        IF (M.GT.22) GO TO 2                                              WANED
39 C                                                                         WANED
40 C   SAVE WANE COORDINATES FOR GRADING PROGRAM                             WANED
41 C                                                                         WANED
42        FLY(M,1) = 0.                                                     WANED
43        FUY(M,1) = V*4.+1.                                                WANED
44        FUX(M,1) = H                                                      WANED
45        FLX(M,1) = OLDH                                                   WANED
46        ID(M,1) = 5                                                       WANED
47 C                                                                         WANED
48 C   WHEN WANE EXTENDS TO END OF BOARD, THIS EDGE IS DONE                  WANED
49 C                                                                         WANED
50      2 IF (H.GE.BDLEN*4.) GO TO 3                                        WANED
51 C                                                                         WANED
52 C   THE NEXT WANE DEFECT BEGINS WHERE THIS ONE ENDS                       WANED
53 C                                                                         WANED
54        OLDH = H                                                          WANED
55        GO TO 1                                                           WANED
56 C                                                                         WANED
57 C                                                                         WANED
58 C   REPEAT FOR OTHER EDGE OF BOARD                                        WANED
59 C                                                                         WANED
60      3 IF ((RB-SQRT(CON2+BOARDW(1)**2))/CON1.GE.BDLEN) RETURN            WANED
61        OLDH = BDLEN*2.                                                   WANED
62        V = 0.                                                            WANED
63 C                                                                         WANED
64 C   FIND END OF WANE DEFECT                                               WANED
65 C                                                                         WANED
66      4 V = V+0.25                                                        WANED
67        SQR = SQRT(CON2+(BOARDW(1)-V)**2)                                 WANED
68        H = INT(AMIN1((RB-SQR)*4./CON1.BDLEN*4.))                         WANED
69        NODEFC(1) = NODEFC(1)+1                                           WANED
70        M = NODEFC(1)                                                     WANED
71 C                                                                         WANED
72 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)    WANED
73 C                                                                         WANED
74        IF (M.GT.22) GO TO 5                                              WANED
75 C                                                                         WANED
```

```
C   SAVE WANE COORDINATES FOR GRADING PROGRAM                          WANED
C                                                                      WANED
      FUY(M.1) = (BOARDW(1)+BOARDW(2))*4.                              WANED
      FLY(M.1) = (BOARDW(1)+BOARDW(2))*4.-V*4.-1.                      WANED
      FUX(M.1) = H                                                     WANED
      FLX(M.1) = OLDH                                                  WANED
      ID(M.1) = 5                                                      WANED
C                                                                      WANED
C   WHEN THE DEFECT EXTENDS TO THE END OF THE BOARD, EXIT              WANED
C                                                                      WANED
    5 IF (H.GE.BDLEN*4.) RETURN                                        WANED
C                                                                      WANED
C   THE NEXT WANE DEFECT BEGINS WHERE THIS ONE ENDS                    WANED
C                                                                      WANED
      OLDH = H                                                         WANED
      GO TO 4                                                          WANED
      RETURN                                                           WANED
      END                                                              WANED
```

*** STATEMENT NUMBERS ***

1	*30	55		
2	38	*50		
3	21	50	*60	
4	*86	91		
5	74	*86		

*** VARIABLES ***

AMIN1	32	68										
BDLEN	15	21	22	32	50	60	61	68	86			
BF	15											
BOARDW	13	15	21	31	60	67	78	79				
CON1	*18	21	32	60	68							
CON2	*20	21	31	60	67							
D	15											
DISTBD	13	15	20									
F	4	12	20									
FLX	13	15	*45	*81								
FLY	13	15	*42	*79								
FUX	13	15	*44	*80								
FUY	13	15	*43	*78								
H	*32	44	50	54	*60	80	86	90				
ID	17	15	*46	*82								
INT	32	68										
K	15											
KNOT$	15											
L	15											
LOG$	15	19										
M	*34	38	42	43	44	45	46	*70	74	78	79	80
	81	82										
NODEFC	12	15	*33	34	*69	70						
OLDH	*22	45	*54	*61	81	*90						
R	13	15										
RAD	19											
RB	15	21	32	60	68							
RCUT	13	15										
SQR	*31	32	*67	68								
SQPT	21	31	60	67								
T	15											
TAN	19											
V	*22	*30	31	43	*62	*66	67	79				
WANED	4											

Subroutine KNOT

```
C   SUBROUTINE 'KNOT' LOCATES THE KNOT DEFECTS ON THE BOARD FACE.      KNOTD
C   ANGLES ARE MEASURED CLOCKWISE WITH 0 DEGREES DEFINED AS THE        KNOTD
C   LINE FROM THE CENTER OF THE LOG PERPENDICULAR TO THE BOARD FACE    KNOTD
C                                                                      KNOTD
C                                                                      KNOTD
      SUBROUTINE KNOTD (KHIGH,KTANG$,KLEN,F)                           KNOTD
C                                                                      KNOTD
      IMPLICIT REAL (K,L)                                              KNOTD
      INTEGER ID(22,2),NODEFC(2),F                                     KNOTD
      REAL BOARDW(2),DISTBD(4),RCUT(4),BDWID$(2),R(4),FLX(26,2),       KNOTD
           FLY(26,2),FUX(26,2),FUY(26,2)                               KNOTD
      COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                         KNOTD
             /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,RCUT,BF KNOTD
C                                                                      KNOTD
C                                                                      KNOTD
C   SEE IF THE KNOT IS LONG ENOUGH TO REACH THE BOARD FACE             KNOTD
C                                                                      KNOTD
      IF (KLEN.LT.DISTBD(F)) RETURN                                    KNOTD
C                                                                      KNOTD
C   CALCULATE BOARD HALF-WIDTH ANGLES, KNOT DEFECT HALF-LENGTH AS      KNOTD
C   PROJECTED ON THE FACE, AND LOG RADIUS AT KNOT HEIGHT               KNOTD
C                                                                      KNOTD
      BDWID$(1) = DEG(ATAN(BOARDW(1)/DISTBD(F)))                       KNOTD
      BDWID$(2) = DEG(ATAN(BOARDW(2)/DISTBD(F)))                       KNOTD
      DY = DISTBD(F)*TAN(RAD(KNOT$))                                   KNOTD
      LRADUS = RB-KHIGH*TAN(RAD(LOG$))                                 KNOTD
C                                                                      KNOTD
C   THE KNOT EFFECTIVELY ENDS AT THE OUTER EDGE OF THE LOG             KNOTD
C                                                                      KNOTD
      IF (KLEN.GT.LRADUS) KLEN = LRADUS                                KNOTD
C                                                                      KNOTD
C   SINCE THE LOG IS TAPERED, THE OUTER BOARDS MAY NOT BE THE FULL LOG KNOTD
C   LENGTH. SO KNOTS ABOVE THE END OF THE BOARD ARE NOT CONSIDERED     KNOTD
C                                                                      KNOTD
      IF (LRADUS.LT.DISTBD(F)) RETURN                                  KNOTD
C                                                                      KNOTD
C   ROTATE THE LOG TO THE CURRENT FACE                                 KNOTD
C                                                                      KNOTD
      IF (F.EQ.2) KTANG$ = AMOD(KTANG$+270..360.)                      KNOTD
      IF (F.EQ.3) KTANG$ = AMOD(KTANG$+180..360.)                      KNOTD
      IF (F.EQ.4) KTANG$ = AMOD(KTANG$+90..360.)                       KNOTD
C                                                                      KNOTD
C   ANGLE OF ROTATION PUTS KNOT COMPLETELY OUTSIDE BOARD               KNOTD
C                                                                      KNOTD
      IF ((KTANG$.GT.180.).AND.((KTANG$+KNOT$).LT.(360.-BDWID$(1)))    KNOTD
        GO TO 9                                                        KNOTD
      IF ((KTANG$.LE.180.).AND.((KTANG$-KNOT$).GT.BDWID$(2))) GO TO 9  KNOTD
C                                                                      KNOTD
C                                                                      KNOTD
C   FIND THE QUADRANT IN WHICH THE KNOT LIES (ASSUME QUADRANT ONE)     KNOTD
C                                                                      KNOTD
C   QUADRANT TWO                                                       KNOTD
C                                                                      KNOTD
      IF ((KTANG$.LT.180.).AND.((KTANG$+KNOT$).GT.BDWID$(2))) GO TO 3  KNOTD
C                                                                      KNOTD
C   QUADRANT THREE                                                     KNOTD
C                                                                      KNOTD
      IF ((KTANG$.GE.180.).AND.((KTANG$-KNOT$).LT.(360.-BDWID$(1))))   KNOTD
        GO TO 4                                                        KNOTD
C                                                                      KNOTD
C   QUADRANT FOUR                                                      KNOTD
C                                                                      KNOTD
      IF (KTANG$.GT.270.) GO TO 5                                      KNOTD
C                                                                      KNOTD
C                                                                      KNOTD
C   QUADRANT ONE                                                       KNOTD
C                                                                      KNOTD
C   SEE IF KNOT CENTER IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES      KNOTD
C                                                                      KNOTD
      IF (KTANG$-KNOT$.LT.0.) GO TO 2                                  KNOTD
C                                                                      KNOTD
C   CALCULATE DISTANCE TO FACE ALONG BOTH SIDES OF KNOT                KNOTD
C                                                                      KNOTD
      ANGBD1 = DISTBD(F)/COS(RAD(KTANG$-KNOT$))                        KNOTD
      ANGBD2 = DISTBD(F)/COS(RAD(KTANG$+KNOT$))                        KNOTD
```

```
C   KNOT IS NOT LONG ENOUGH TO REACH FACE
C
      IF (KLEN.LT.ANGBD1) GO TO 9
C
C   FIND INTERSECTION OF NEAR SIDE OF KNOT AND FACE
C
      XR = BOARDW(2)-DISTBD(F)*TAN(RAD(KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD2) GO TO 1
C
C   FAR SIDE OF KNOT REACHES FACE
C
      XL = BOARDW(2)-DISTBD(F)*TAN(RAD(KTANG$+KNOT$))
      FULWID = (XR-XL)/2.
      GO TO 8
C
C   FAR SIDE OF KNOT DOES NOT REACH FACE
C
    1 XL = BOARDW(2)-SQRT(KLEN**2-DISTBD(F)**2)
      FULWID = DISTBD(F)*TAN(RAD(KTANG$+KNOT$))
     .  -DISTBD(F)*TAN(RAD(KTANG$-KNOT$))
      GO TO 9
C
C   KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES
C
    2 XL = AMIN1(SQRT(KLEN**2-DISTBD(F)**2),
     .  DISTBD(F)*TAN(RAD(KTANG$+KNOT$)))
      XL = BOARDW(2)-XL
      XR = AMIN1(SQRT(KLEN**2-DISTBD(F)**2),
     .  DISTBD(F)*TAN(RAD(KNOT$-KTANG$)))
      XR = BOARDW(2)+XR
C
C   KNOTS NEARLY PERPENDICULAR HAVE THEIR WIDTH ESTIMATED BY THEIR
C   LENGTH
C
      FULWID = D**2.
      GO TO 8
C
C   QUADRANT TWO
C
    3 ANGBD1 = DISTBD(F)/COS(RAD(KTANG$-KNOT$))
C
C   TOO SHORT TO REACH FACE
C
      IF (KLEN.LT.ANGBD1) GO TO 9
      XR = BOARDW(2)+SQRT(ANGBD1**2-DISTBD(F)**2)
      XL = BOARDW(2)-SQRT(KLEN**2-DISTBD(F)**2)
      IF ((KTANG$+KNOT$).GE.89.5)
     .  FULWID = LRADUS-DISTBD(F)*TAN(RAD(KTANG$-KNOT$))
      IF ((KTANG$+KNOT$).LT.89.5)
     .  FULWID = AMIN1(LRADUS,DISTBD(F)*TAN(RAD(KTANG$+KNOT$)))
     .    -DISTBD(F)*TAN(RAD(KTANG$-KNOT$))
      GO TO 9
C
C   QUADRANT THREE
C
    4 ANGBD1 = DISTBD(F)/COS(RAD(360.-KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD1) GO TO 9
      XR = BOARDW(2)+SQRT(KLEN**2-DISTBD(F)**2)
      XL = BOARDW(2)+SQRT(ANGBD1**2-DISTBD(F)**2)
      IF (KTANG$-KNOT$).LE.270.5)
     .  FULWID = LRADUS-DISTBD(F)*TAN(RAD(360.-KTANG$-KNOT$))
      IF ((KTANG$-KNOT$).GT.270.5)
     .  FULWID = AMIN1(LRADUS,DISTBD(F)*TAN(RAD(360.-KTANG$+KNOT$)))
     .    -DISTBD(F)*TAN(RAD(360.-KTANG$-KNOT$))
      GO TO 8
C
C   QUADRANT FOUR
C
    5 IF (360.-KTANG$-KNOT$.LT.0.) GO TO 7
      ANGBD1 = DISTBD(F)/COS(RAD(360.-KTANG$-KNOT$))
      ANGBD2 = DISTBD(F)/COS(RAD(360.-KTANG$+KNOT$))
      IF (KLEN.LT.ANGBD1) GO TO 9
      XL = BOARDW(2)+DISTBD(F)*TAN(RAD(360.-KTANG$-KNOT$))
      IF (KLEN.LT.ANGBD2) GO TO 6
C
C   FAR SIDE OF KNOT REACHES FACE
C
      XR = BOARDW(2)+DISTBD(F)*TAN(RAD(360.-KTANG$+KNOT$))
      FULWID = (XR-XL)/2.
      GO TO 8
C
C   FAR SIDE OF KNOT DOES NOT REACH FACE
C
    6 XR = BOARDW(2)+SQRT(KLEN**2-DISTBD(F)**2)
      FULWID = DISTBD(F)*TAN(RAD(360.-KTANG$+KNOT$))
     .  -DISTBD(F)*TAN(RAD(360.-KTANG$-KNOT$))
      GO TO 8
C
C   KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES
C
    7 XL = AMIN1(SQRT(KLEN**2-DISTBD(F)**2),
     .  DISTBD(F)*TAN(RAD(KTANG$+KNOT$-360.)))
      XL = BOARDW(2)-XL
      XR = AMIN1(SQRT(KLEN**2-DISTBD(F)**2),
     .  DISTBD(F)*TAN(RAD(360.-KTANG$+KNOT$)))
      XR = BOARDW(2)+XR
      FULWID = D**2.
C
C   IF A KNOT COMPLETELY INTERSECTS THE FACE, ITS LENGTH IS EXACTLY AS
C   MEASURED ON THE FACE.  OTHERWISE, ITS LENGTH IS ESTIMATED AS A
C   PROPORTION OF ITS PROJECTED LENGTH
C
    8 D$ = AMIN1(D/.707*(XR-XL)*2./FULWID))
      XB = HIGH-D$
      XT = HIGH+D$
C
C   DEFECT LOCATIONS FOUND.  CHECK THAT THEY DO NOT EXTEND BEYOND THE
C   BOARD EDGES AND CONVERT TO QUARTER INCH UNITS FOR THE GRADING
C   PROGRAM
C
      XL = MAX0(0.INT(XL*4.))
      XR = MIN0(INT(BOARDW(1)+BOARDW(2))*4.),INT(XR*4.+1.))
      XB = MAX0(0.INT(XB*4.))
      XT = MIN0(INT(BDLEN*4.),INT(XT*4.+1.))
C
C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)
C
      NODEFC(1) = NODEFC(1)+1
      IF (NODEFC(1).GT.22) RETURN
C
C   SAVE KNOT COORDINATES FOR GRADING PROGRAM
C
      FL(NODEFC(1),1) = XL
      FL(NODEFC(1),2) = XR
      FL(NODEFC(1),3) = XB
      FL(NODEFC(1),4) = XT
      IDN(NODEFC(1),1) = F
C
C   RETURN KNOT ANGLES TO ORIGINAL VALUES
C
    9 IF (F.EQ.2) KTANG$ = AMOD(KTANG$+90..360.)
      IF (F.EQ.3) KTANG$ = AMOD(KTANG$+180..360.)
      IF (F.EQ.4) KTANG$ = AMOD(KTANG$+270..360.)
      RETURN
      END
```

*** STATEMENT NUMBERS ***

1	83	*93						
2	70	*100						
3	54	*115						
4	58	*131						
5	63	*144						
6	149	*153						
7	144	*166						
8	89	96	111	127	140	155	162	*178

```
     9       45   47   78  119  132  147 *206

                          *** VARIABLES ***

AMAX0       186  188
AMIN0       187  189
AMIN1       188  124  137  166  169  178
AMINI       183
AMOD         39   40   41  206  207  208
ANGBD1      *74   78 *115  119  120 *131  132  134 *145  147
ANGBD2      *75   83 *146  149
ATAN         23   24
BDLEN        12  189
BDW!!$       10 *23  *24   45   47   54   58
BF           12
BOARDW       10   12   23   24   82   87   93  102  105  120  121  133
            134  148  153  159  168  171  187
COS          74   75  115  131  145  146
D            12
DEG          23   24
DISTBD       10   12   18   23   24   25   35   74   75   82   87   93
             94  100  103  115  120  121  122  124  131  133  134  135
            137  145  146  148  153  159  160  166  169
DY          *25  110  172 *178  179  180
F            6    9   18   23   24   25   35   39   40   41   74   75
             82   87   93   94  100  103  115  120  121  122  124  131
            133  134  135  137  145  146  148  153  159  160  166  169
            206  207  208
FLX          10   12 *200
FLY          10   12 *198
FULWID      *88  *94 *110 *122 *124 *135 *137 *154 *160 *172  178
FUX          10   12 *201
FUY          10   12 *199
ID            9   12 *202
INT         186  187  188  189
K            12
KHIGH         6   26  179  180
KLEN          6   18 *30   78   83   93  100  103  119  121  132  133
            147  149  159  166  169
KNOTS        12   25   45   47   54   58   70   74   75   82   87   94
            100  103  115  122  124  131  135  137  144  145  146  148
            153  160  166  169
KNOTD         6
KTANGS        6 *39  *40  *41   45   47   54   58   63   70   74   75
             82   87   94  100  103  115  122  124  131  135  137  144
            145  146  148  153  160  166  169 *206 *207 *208
L            12
LOGS         12   26
LRADUS      *26   30   35  122  124  135  137
NODEFC        9   12 *193  194  198  199  200  201  202
R            10   12
RAD          25   26   74   75   82   87   94  100  103  115  122  124
            131  135  137  145  146  148  153  160  166  169
RB           12   26
RCUT         10   12
SQRT         93  100  103  120  121  133  134  159  166  169
T            12
TAN          25   26   82   87   94  100  103  122  124  135  137  148
            153  160  166  169
XL          *87   88  *93 *100 *102 *121 *134 *148  154 *166 *168  178
           *186  198
XR          *82   88 *103 *105 *120 *133 *153  154 *159 *169 *171  178
           *187  199
YB          *179 *188  200
YT          *180 *189  201
```

Subroutine CORE

```
C   SUBROUTINE 'CORE' LOCATES THE CORE DEFECT ON THE BOARD FACE
C
C
      SUBROUTINE CORED (CRADUS,COFSET,CANG$,F)
C
      IMPLICIT REAL(K,L)
      INTEGER ID(22,2),NODEFC(2),F
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),DISTBD(4),BOARDW(2),
     .     RCUT(4),R(4)
      COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R,RCUT,BF
     .      /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
C
C
C   ROTATE LOG TO THE FACE BEING CUT
C
      TCANG$ = CANG$
      IF (F.EQ.2) TCANG$ = AMOD(CANG$+270.,360.)
      IF (F.EQ.3) TCANG$ = AMOD(CANG$+180.,360.)
      IF (F.EQ.4) TCANG$ = AMOD(CANG$+90.,360.)
C
C   FIND DISTANCE TO THE BOARD FACE FROM THE CENTER OF THE CORE. EXIT
C   IF THE BOARD FACE IS BEYOND THE COPE RADIUS
C
      TDIST = DISTBD(F)-COFSET*COS(RAD(TCANG$))
      IF (CRADUS.LE.TDIST) RETURN
      NODEFC(1) = NODEFC(1)+1
C
C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)
C
      IF (NODEFC(1).GT.22) RETURN
C
C   LOCATE THE CENTER POINT OF THE INTERSECTION OF THE BOARD FACE AND
C   THE COPE DEFECT.  CALCULATE THE DISTANCE ON THE BOARD FROM THE
C   CENTER POINT TO THE EDGES OF THE COPE DEFECT.  THE COPE DEFECT
C   IS NOT TAPERED, SO IT WILL EXTEND THE FULL LENGTH OF THE BOARD
C
      CONST = SQRT(CRADUS**2-TDIST**2)
      TBDCTR = COFSET*SIN(RAD(TCANG$))
      XP = BOARDW(2)+CONST-TBDCTR
      XL = BOARDW(2)-CONST-TBDCTR
C
C   SAVE COPE DEFECT COORDINATES FOR GRADING PROGRAM
C
      FUX(NODEFC(1),1) = INT(BDLEN*4.)
      FLX(NODEFC(1),1) = 0.0
      FUY(NODEFC(1),1) = AMIN0(INT((BOARDW(1)+BOARDW(2))*4.),
     .   INT(XP*4.+1.))
      FLY(NODEFC(1),1) = AMAX0(0,INT(XL*4.))
      ID(NODEFC(1),1) = F
      RETURN
      END
```

```
                          *** VARIABLES ***

AMAX0       49
AMIN0       46
AMOD        17   18   19
BDLEN       10   44
BF          19
BOARDW       8   10   39   40   46
CANG$        1   16   17   18   19
COFSET       4   24   38
CONST       37   39   40
CORED        4
COS         24
```

```
CRADUS          4    25    37
D              10
DISTBD          9    10    24
F               4     7    17    18    15    24
FLX             8    10   *45
FLY             8    10   *48
FUX             8    10   *44
FUY             8    10   *46
ID              7    10   *49
INT            44    46    48
K              10
KNOTS          10
L              10
LOGS           10
NODEFC          7    10   *26    38    44    45    46    48    49
R               8    10
RAD            24    38
RB             10
RCUT            8    10
SIN            38
SQRT           37
T              10
TBDCTR         *38    39    40
TCANGS         *16   *17   *18   *19    24    38
TDIST          *24    25    37
XL             *40    48
XR             *39    46
```

Subroutine GRADE

```
 1 C   SUBROUTINE 'GRADE' CALLS THE U.S. FOREST PRODUCTS LABORATORY        GRADE
 2 C   GRADING PROGRAM                                                     GRADE
 3 C                                                                       GRADE
 4 C                                                                       GRADE
 5       SUBROUTINE GRADE (NPG)                                           GRADE
 6 C                                                                       GRADE
 7       INTEGER ID(22,2),NODEFC(2),IX(22)                                GRADE
 8       REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                     GRADE
 9       COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                         GRADE
10 C                                                                       GRADE
11 C                                                                       GRADE
12       M = NODEFC(1)                                                    GRADE
13       IF (M.GT.22) GO TO 3                                             GRADE
14       IF (M.EQ.0) GO TO 2                                              GRADE
15       DO 1 J=1,M                                                       GRADE
16         IX(J) = ID(J,1)                                                GRADE
17     1 CONTINUE                                                         GRADE
18     2 NPG = 1                                                          GRADE
19       CALL GRD (M,IX,NPG,SM)                                           GRADE
20       RETURN                                                           GRADE
21 C                                                                       GRADE
22 C   IF NUMBER OF DEFECTS IS MORE THAN GRADING PROGRAM CAN HANDLE,       GRADE
23 C   THE GRADE IS 3A/3B                                                 GRADE
24 C                                                                       GRADE
25     3 NPG = 5                                                          GRADE
26       WRITE (6,100)                                                    GRADE
27   100 FORMAT (' DEFECT LIMIT EXCEEDED')                                GRADE
28       RETURN                                                           GRADE
29       END                                                              GRADE
```

*** STATEMENT NUMBERS ***

```
  1       15   *17
  2       14   *18
  3       13   *25
100       26   *27
```

*** VARIABLES ***

```
FLX          8     9
FLY          8     9
FUX          8     9
FUY          8     9
GRADE        5
GRD         19
ID           7     9    16
IX           7   *16    19
J          *15    16
M          *12    13    14    15    19
NODEFC       7     9    12
NPG          5   *18    19   *25
SM          19
```

Subroutine PRICE

```
 1 C   SUBROUTINE 'PRICE' DETERMINES THE BOARD GRADE BASED ON THE GRADES    PRICED
 2 C   OF BOTH SIDES (OLD.NPG) AND CALCULATES THE BOARD VALUE               PRICED
 3 C                                                                        PRICED
 4 C                                                                        PRICED
 5       SUBROUTINE PRICED (OLD.NPG.TVAL.PERC)                              PRICED
 6 C                                                                        PRICED
 7       IMPLICIT REAL (K.L)                                                PRICED
 8       INTEGER OLD                                                        PRICED
 9       REAL PERC(5).BOARDW(2).R(4).DISTBD(4).RCUT(4)                      PRICED
10       COMMON /BOARD/ L.D.K.T.LOG$.RB.DISTBD.BDLEN.BOARDW.KNOT$.R.RCUT.BF PRICED
11              /PRICE/ FAS.SEL.ONEC.TWOC.THRB                              PRICED
12 C                                                                        PRICED
13 C                                                                        PRICED
14 C   DETERMINE THE BOARD GRADE                                            PRICED
15 C                                                                        PRICED
16       IF (OLD.EQ.5.OR.NPG.EQ.5) GO TO 3                                  PRICED
17       IF (OLD.EQ.2.OR.NPG.EQ.2) GO TO 1                                  PRICED
18       IF (OLD.EQ.NPG) GO TO 4                                            PRICED
19       NPG = MAX0(OLD.NPG)                                                PRICED
20       IF (NPG.EQ.4) GO TO 8                                              PRICED
21       NPG = 2                                                            PRICED
22       GO TO 6                                                            PRICED
23     1 IF (OLD.EQ.4.OR.NPG.EQ.4) GO TO 2                                  PRICED
24       NPG = 3                                                            PRICED
25       GO TO 4                                                            PRICED
26     2 NPG = 4                                                            PRICED
27       GO TO 4                                                            PRICED
28     3 NPG = 5                                                            PRICED
29 C                                                                        PRICED
30 C   AND CALCULATE THE BOARD VALUE                                        PRICED
31 C                                                                        PRICED
32     4 GO TO (5.6.7.8.9). NPG                                             PRICED
33     5 V = BF*FAS                                                         PRICED
34       GO TO 10                                                           PRICED
35     6 V = BF*SEL                                                         PRICED
36       GO TO 10                                                           PRICED
37     7 V = BF*ONEC                                                        PRICED
38       GO TO 10                                                           PRICED
39     8 V = BF*TWOC                                                        PRICED
40       GO TO 10                                                           PRICED
41     9 V = BF*THRB                                                        PRICED
42 C                                                                        PRICED
43 C   INCREASE SURFACE MEASURE IN THIS GRADE AND THE TOTAL LOG VALUE       PRICED
44 C                                                                        PRICED
45    10 PERC(NPG) = BF+PERC(NPG)                                           PRICED
46       TVAL = TVAL+V                                                      PRICED
47       RETURN                                                             PRICED
48       END                                                                PRICED
```

*** VARIABLES ***

```
BDLEN      10
BF         10    33    35    37    39    41    45
BOARDW      9    10
D          10
DISTBD      9    10
FAS        10    33
K          10
KNOT$      10
L          10
LOG$       10
MAX0       19
NPG         5    16    17    18   *19    20   *21    23   *24   *26   *28    32
           45
OLD         5     8    16    17    18    19    23
ONEC       10    37
PERC        5     9   *45
PRICED      5
R           9    10
RB         10
RCUT        9    10
SEL        10    35
T          10
THRB       10    41
TVAL        5   *46
TWOC       10    39
V          *33   *35   *37   *39   *41    46
```

*** STATEMENT NUMBERS ***

```
 1       17   *23
 2       23   *26
 3       16   *28
 4       18    25    27   *32
 5       32   *33
 6       22    32   *35
 7       32   *37
 8       29    32   *39
 9       32   *41
10       34    36    38    40   *45
```

Subroutine DECIDE

```
 1 C   SUBROUTINE 'DECIDE' FINDS THE LOG FACE THAT SHOULD BE CUT NEXT.
 2 C   USUALLY THIS IS THE FACE WITH THE HIGHEST GRADE. BUT, IF TWO OR
 3 C   MORE FACES HAVE THE SAME GRADE, THE FACE WITH THE LARGEST SURFACE
 4 C   MEASURE IS USED.  IF TWO OR MORE FACES HAVE THE SAME GRADE AND
 5 C   SURFACE MEASURE, THE LAST FACE CONSIDERED IS USED
 6 C
 7 C
 8       SUBROUTINE DECIDE (F,*)
 9 C
10       IMPLICIT INTEGER (C,F,G)
11       DIMENSION CMPLET(4),GRDCOM(4),SMF(4)
12       COMMON /DECID/ CMPLET,GDBEST,GRDCOM,SMBEST,SMF
13 C
14 C
15       JCMPLT = 0
16       GDBEST = 6
17 C
18 C   FOR EACH FACE OF THE LOG...
19 C
20       DO 5 J=1,4
21 C
22 C   IS FACE COMPLETELY CUT?
23 C
24          IF (CMPLET(J).EQ.1) GO TO 2
25 C
26 C   IF NOT, IS THIS FACE BETTER THAN...
27 C
28          IF (GRDCOM(J).LT.GDBEST) GO TO 3
29 C
30 C   OR EQUAL TO THE 'BEST' FACE?
31 C
32          IF (GRDCOM(J).EQ.GDBEST) GO TO 4
33          GO TO 5
34 C
35 C   IF COMPLETELY CUT, INCREASE COUNT AND CHECK NEXT FACE
36 C
37       2  JCMPLT = JCMPLT+1
38          GO TO 5
39 C
40 C   THIS FACE IS BETTER.  SAVE GRADE AND SURFACE MEASURE; CHECK
41 C   NEXT FACE
42 C
43       3  F = J
44          GDBEST = GRDCOM(J)
45          SMBEST = SMF(J)
46          GO TO 5
47 C
48 C   USE SURFACE MEASURE TO BREAK TIES
49 C
50       4  IF (SMF(J).LT.SMBEST) GO TO 5
51          F = J
52          SMBEST = SMF(J)
53       5 CONTINUE
54 C
55 C   WHEN ALL FOUR FACES ARE COMPLETELY CUT, ROTATE LOG 15 DEGREES
56 C   AND REPROCESS
57 C
58       IF (JCMPLT.EQ.4) RETURN1.
59       RETURN
60       END
```

***** STATEMENT NUMBERS *****

2	24	#37					
3	28	*43					
4	32	#50					
5	20	33	38	46	50	#53	

***** VARIABLES *****

CMPLET	11	12	24							
DECIDE	8									
F	8	*43	*51							
GDBEST	13	*16	28	32	*44					
GRDCOM	11	12	28	32	44					
J	*20	24	28	32	43	44	45	50	51	52
JCMPLT	*15	#37	58							
SMBEST	12	*45	50	#52						
SMF	11	12	45	50	52					

Function DEG

```
1 C   FUNCTION 'DEG' CONVERTS ITS ARGUMENT (IN RADIANS) TO DEGREES      DEG
2 C                                                                     DEG
3 C                                                                     DEG
4 C                                                                     DEG
5       FUNCTION DEG (A)                                                DEG
6 C                                                                     DEG
7       DEG = A*180.0/3.141592                                          DEG
8       RETURN                                                          DEG
9       END                                                             DEG
```

**** VARIABLES ****

A	5	7
DEG	5	*7

Function RAD

```
1 C   FUNCTION 'RAD' CONVERTS ITS ARGUMENT (IN DEGREES) TO RADIANS      RAD
2 C                                                                     RAD
3 C                                                                     RAD
4 C                                                                     RAD
5       FUNCTION RAD (A)                                                RAD
6 C                                                                     RAD
7       RAD = A*3.141592/180.0                                          RAD
8       RETURN                                                          RAD
9       END                                                             RAD
```

**** VARIABLES ****

A	5	7
RAD	5	*7

Live Sawing (LIVE)

```
C  'LIVE' SAWS THE LOG THROUGH ITS CENTRAL AXIS.  THE PLANE OF EACH     LIVE
C  SUBSEQUENT SAW CUT (AND HENCE EACH BOARD FACE) IS PARALLEL TO THIS   LIVE
C  FIRST CUT.  IN ADDITION, THE CORE DEFECT IS RIPPED OUT OF ANY BOARDS LIVE
C  IN WHICH IT APPEARS AND THE RESULTING BOARDS REGRADED                LIVE
C                                                                       LIVE
C                                                                       LIVE
      IMPLICIT REAL (K,L)                                               LIVE
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),PERC(5),PERCRP(5),   LIVE
     .     ANGLE(40),HEIGHT(40),KTLEN(40),DAT*8                         LIVE
      INTEGER ID(22,2),NODEFC(2),CORFLG,OLD,GRDRGT,GRDLFT,GRDMID,F      LIVE
      COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R        LIVE
     .       /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                          LIVE
     .       /FORRIP/ RPLOSS,RPKERF,LFTLOC,RGTLOC,GRDRGT,GRDLFT,GRDMID, LIVE
     .                TLOSS                                            LIVE
     .       /PRICE/ FAS,SEL,ONEC,TWOC,THRB                           LIVE
C                                                                       LIVE
C                                                                       LIVE
C  THIS PROGRAM ASSUMES INPUT FROM UNIT 5 AND OUTPUTS TO UNITS 6 AND 8  LIVE
C                                                                       LIVE
C  GET LOG DIAMETER (IN.), LOG LENGTH (IN.), KERF SIZES (IN.), AND      LIVE
C  BOARD THICKNESS (IN.)                                                LIVE
C                                                                       LIVE
    1 READ (5,109,END=17) D                                             LIVE
      READ (5,109) L                                                    LIVE
      READ (5,110) K,RPKERF                                             LIVE
      READ (5,109) T                                                    LIVE
C                                                                       LIVE
C  GET KNOT HALF-ANGLE (DEGREES) AND LOG HALF-TAPER (DEGREES)           LIVE
C                                                                       LIVE
      READ (5,109) KNOT$                                                LIVE
      READ (5,109) LOG$                                                 LIVE
C                                                                       LIVE
C  GET CORE DEFECT PARAMETERS: DIAMETER (IN.), LINEAR OFFSET (IN.),     LIVE
C  AND ANGULAR OFFSET (DEGREES)                                         LIVE
C                                                                       LIVE
      READ (5,105) CORDIA                                               LIVE
      READ (5,105) COFSET                                               LIVE
      READ (5,105) CANG$                                                LIVE
C                                                                       LIVE
C  GET PRICE PER BOARD FOOT FOR EACH GRADE; NUMBER OF KNOTS             LIVE
C                                                                       LIVE
      READ (5,120) FAS,SEL,ONEC,TWOC,THRB                               LIVE
      READ (5,101) MAX                                                  LIVE
C                                                                       LIVE
C  GET DATE AND CALCULATE RADIUS OF CORE DEFECT                         LIVE
C                                                                       LIVE
      CALL DATE (DAT)                                                   LIVE
      CRADUS=CORDIA/2.                                                  LIVE
C                                                                       LIVE
C  GET KNOT ANGLES, HEIGHTS, AND LENGTHS                                LIVE
C                                                                       LIVE
      DO 2 J=1,MAX                                                      LIVE
        READ (5,104) ANGLE(J),HEIGHT(J)                                 LIVE
    2 CONTINUE                                                          LIVE
      DO 3 J=1,MAX                                                      LIVE
        READ (5,105) KTLEN(J)                                           LIVE
    3 CONTINUE                                                          LIVE
C                                                                       LIVE
C  CALCULATE LOG RADIUS AT TOP AND BOTTOM; TOTAL LOG CUBIC FEET         LIVE
C                                                                       LIVE
      RI = D/2.                                                         LIVE
      RB = RI+L*TAN(RAD(LOG$))                                          LIVE
      LVOL = 1/3.*3.141593*(RB**2+RB*RI+RI**2)*L/144.                   LIVE
C                                                                       LIVE
C  OUTPUT HEADER                                                        LIVE
C                                                                       LIVE
      WRITE (6,121) DAT                                                 LIVE
      WRITE (6,122) L,D,LOG$,LVOL                                       LIVE
      WRITE (6,103) MAX                                                 LIVE
      DO 4 J=1,MAX                                                      LIVE
        WRITE (6,106) ANGLE(J),HEIGHT(J),KTLEN(J)                       LIVE
    4 CONTINUE                                                          LIVE
      WRITE (6,123) KNOT$                                               LIVE
      WRITE (6,114) CRADUS,COFSET,CANG$                                 LIVE
      WRITE (6,124) K,RPKERF,T                                          LIVE
      WRITE (6,125) FAS,SEL,ONEC,TWOC,THRB                              LIVE
      WRITE (8,200) L,D,MAX,CRADUS,COFSET,CANG$,LVOL,K,T,KNOT$,LOG$,    LIVE
     .              RPKERF                                              LIVE
      WRITE (8,201) (KTLEN(J),J=1,MAX)                                  LIVE
      WRITE (8,201) (HEIGHT(J),J=1,MAX)                                 LIVE
      WRITE (8,201) (ANGLE(J),J=1,MAX)                                  LIVE
      WRITE (8,202) FAS,SEL,ONEC,TWOC,THRB                              LIVE
C                                                                       LIVE
C  INITIALIZE VARIABLES FOR CALCULATING HIGH, LOW, AND AVERAGE YIELDS   LIVE
C  FOR EACH LOG                                                         LIVE
C                                                                       LIVE
      HIGH$ = 0.                                                        LIVE
      SMALL$ = 999.                                                     LIVE
      AVG$ = 0.                                                         LIVE
      HIRIP$ = 0.                                                       LIVE
      SMRIP$ = 999.                                                     LIVE
      AVRIP$ = 0.                                                       LIVE
      AVRIP = 0.                                                        LIVE
      HIRIP = 0.                                                        LIVE
      LORIP = 999.                                                      LIVE
C                                                                       LIVE
C                                                                       LIVE
C  SAW LOG IN 12 DIFFERENT ROTATIONAL POSITIONS, 15 DEGREES APART, TO   LIVE
C  DETERMINE THE ORIENTATION GIVING THE HIGHEST YIELD                   LIVE
C                                                                       LIVE
      DO 16 IN=1,12                                                     LIVE
C                                                                       LIVE
C  INITIALIZE FOR EACH POSITION                                         LIVE
C                                                                       LIVE
        BF = 0.0                                                        LIVE
        NBD = 1                                                         LIVE
        TOTS = 0.                                                       LIVE
        RPTOTS = 0.                                                     LIVE
        TVAL = 0.0                                                      LIVE
        TVALRP = 0.0                                                    LIVE
        DO 5 J=1,5                                                      LIVE
          PERC(J) = 0.0                                                 LIVE
          PERCRP(J) = 0.0                                               LIVE
    5   CONTINUE                                                        LIVE
        RPLOSS = 0.                                                     LIVE
        CORFLG = 0                                                      LIVE
C                                                                       LIVE
C                                                                       LIVE
C  FOR BOTH SIDES OF THE LOG...                                         LIVE
C                                                                       LIVE
        DO 13 F=1,2                                                     LIVE
C                                                                       LIVE
C  INITIALIZE PORTION OF LOG TO BE CUT... THIS SETS THE DEPTH OF THE    LIVE
C  FIRST CUT                                                            LIVE
C                                                                       LIVE
          R = RB+K/2.                                                   LIVE
C                                                                       LIVE
C  CUT BOARDS FROM THIS FACE UNTIL FACE IS COMPLETELY CUT.  THE LOG IS  LIVE
C  CUT FROM THE INSIDE OUT                                              LIVE
C                                                                       LIVE
    6     CALL KERFL (&11,BF)                                           LIVE
C                                                                       LIVE
C  FOR BOTH SIDES OF THE BOARD...                                       LIVE
C                                                                       LIVE
          DO 10 I=1,2                                                   LIVE
C                                                                       LIVE
C  INITIALIZE DEFECT ARRAYS, EXCEPT F..(26,1), WHICH HOLDS THE BOARD    LIVE
C  DIMENSIONS                                                           LIVE
C                                                                       LIVE
            DO 7 J=1,25                                                 LIVE
              FLX(J,I) = -9999.0                                        LIVE
              FUX(J,I) = -9999.0                                        LIVE
              FLY(J,I) = -9999.0                                        LIVE
              FUY(J,I) = -9999.0                                        LIVE
    7       CONTINUE                                                    LIVE
            DO 8 J=1,22                                                 LIVE
              ID(J,I) = 0                                               LIVE
    8       CONTINUE                                                    LIVE
            NODEFC(I) = 0                                               LIVE
C                                                                       LIVE
```

```
C   PUT IN CORE DEFECT                                                    LIVE
C                                                                         LIVE
            CALL COREL (CRADUS,COFSET,CANG$,CORFLG,I)                     LIVE
C                                                                         LIVE
C   PUT IN KNOTS                                                          LIVE
C                                                                         LIVE
            DO 9 J=1,MAX                                                  LIVE
              CALL KNOTL (HEIGHT(J),KTLEN(J),ANGLE(J))                    LIVE
    9       CONTINUE                                                      LIVE
C                                                                         LIVE
C   PUT IN WANE DEFECTS                                                   LIVE
C                                                                         LIVE
            CALL WANEL                                                    LIVE
C                                                                         LIVE
C   AND GRADE THE FACE                                                    LIVE
C                                                                         LIVE
            CALL GRADE (NPG)                                              LIVE
C                                                                         LIVE
C   SAVE GRADE OF FIRST SIDE OF BOARD                                     LIVE
C                                                                         LIVE
            IF (I.EQ.1) OLD = NPG                                         LIVE
C                                                                         LIVE
C   DETERMINE BOARD GRADE AND VALUE BASED ON GRADES OF BOTH FACES         LIVE
C                                                                         LIVE
            IF (I EQ.2) CALL PRICEL (BF,OLD,NPG,TVAL,PERC,V)              LIVE
C                                                                         LIVE
C   RIP CORE DEFECT OUT OF BOARD                                          LIVE
C                                                                         LIVE
            CALL RERIP (TVALRP,PERCRP,NPG,V,CORFLG,I,BF)                  LIVE
C                                                                         LIVE
C   SUBTRACT BOARD THICKNESS AND PROCESS THE INNER FACE                   LIVE
C                                                                         LIVE
            DISTBD = DISTBD-T                                             LIVE
   10     CONTINUE                                                       LIVE
C                                                                         LIVE
C   INCREASE BOARD COUNT AND CUT ANOTHER BOARD                            LIVE
C                                                                         LIVE
          NBD = NBD+1                                                     LIVE
          GO TO 6                                                         LIVE
C                                                                         LIVE
C   TURN LOG 180 DEGREES TO CUT OTHER SIDE                                LIVE
C                                                                         LIVE
   11     DO 12 J=1,MAX                                                  LIVE
            ANGLE(J) = AMOD(ANGLE(J)+180.0,360.0)                         LIVE
   12     CONTINUE                                                       LIVE
          CANG$ = AMOD(CANG$+180.0,360.0)                                 LIVE
   13   CONTINUE                                                         LIVE
C                                                                         LIVE
C   PRINT RESULTS FOR THIS POSITION                                       LIVE
C                                                                         LIVE
        IROTAT = INX*15-15                                                LIVE
        WRITE (6,100) IROTAT                                              LIVE
        WRITE (6,112) (PERC(J),J=1,5)                                     LIVE
        TOTS = PERC(1)+PERC(2)+PERC(3)+PERC(4)+PERC(5)                    LIVE
        WRITE (6,111) TOTS                                                LIVE
        WRITE (8,203) IROTAT                                              LIVE
        WRITE (8,204) (PERC(J),J=1,5)                                     LIVE
        WRITE (8,204) TOTS                                                LIVE
        DO 14 J=1,5                                                       LIVE
          PERC(J) = (PERC(J)/LVOL)*100.                                   LIVE
          PERCRP(J) = (PERCRP(J)/LVOL)*100.                               LIVE
          RPTOTS = RPTOTS+PERCRP(J)                                       LIVE
   14   CONTINUE                                                         LIVE
        TOTS = TOTS*100./LVOL                                             LIVE
        WRITE (6,107) (ANGLE(J),J=1,MAX)                                  LIVE
        WRITE (6,108) (PERC(J),J=1,5),TVAL,(PERCRP(J),J=1,5),TVALRP       LIVE
        WRITE (6,113) TOTS                                                LIVE
        WRITE (6,118) RPLOSS                                              LIVE
        WRITE (8,205) (PERC(J),J=1,5),(PERCRP(J),J=1,5)                   LIVE
        WRITE (8,204) TVAL,TOTS,TVALRP,RPLOSS,RPTOTS                      LIVE
C                                                                         LIVE
C   SAVE HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG                       LIVE
C                                                                         LIVE
        AVG$ = AVG$+TVAL                                                  LIVE
        AVRIP$ = AVRIP$+TVALRP                                            LIVE
        IF (TVAL.GT.HIGH$) HIGH$ = TVAL                                   LIVE
        IF (TVAL.LT.SMALL$) SMALL$ = TVAL                                 LIVE
        IF (TVALRP.GT.HIRIP$) HIRIP = RPTOTS                              LIVE
        IF (TVALRP.LT.SMRIP$) LORIP = RPTOTS                              LIVE
        IF (TVALRP.GT.HIRIP$) HIRIP$ = TVALRP                             LIVE
        IF (TVALRP.LT.SMRIP$) SMRIP$ = TVALRP                             LIVE
        AVRIP = AVRIP+RPTOTS                                              LIVE
C                                                                         LIVE
C   ROTATE LOG BY 15 DEGREES AND REPROCESS                                LIVE
C                                                                         LIVE
        DO 15 J=1,MAX                                                     LIVE
          ANGLE(J) = AMOD(ANGLE(J)+15.,360.0)                             LIVE
   15   CONTINUE                                                         LIVE
        CANG$ = AMOD(CANG$+15.0,360.0)                                    LIVE
   16 CONTINUE                                                            LIVE
C                                                                         LIVE
C   PRINT HIGH, LOW, AND AVERAGE YIELDS FOR THIS LOG                      LIVE
C                                                                         LIVE
      AVRIP = AVRIP/12.                                                   LIVE
      AVG$ = AVG$/12.                                                     LIVE
      AVRIP$ = AVRIP$/12.                                                 LIVE
      WRITE (6,115) HIGH$,AVG$,SMALL$                                     LIVE
      WRITE (6,116) HIRIP$,AVRIP$,SMRIP$                                  LIVE
      WRITE (6,119) HIRIP,AVRIP,LORIP                                     LIVE
C                                                                         LIVE
C   LOG COMPLETELY PROCESSED, READ PARAMETERS FOR NEXT LOG                LIVE
C                                                                         LIVE
      GO TO 1                                                             LIVE
C                                                                         LIVE
   17 STOP                                                                LIVE
C                                                                         LIVE
C   FORMATS FOR DEVICE 6 (PRINTER)                                        LIVE
C                                                                         LIVE
  100 FORMAT (2(/),' ROTATION IS',I4)                                     LIVE
  101 FORMAT (I2)                                                         LIVE
  103 FORMAT (' THERE ARE',I3,' KNOTS IN THIS LOG',//,4X,'ANGLE  ',       LIVE
     .  'HEIGHT  LENGTH')                                                 LIVE
  104 FORMAT (2F6.2)                                                      LIVE
  105 FORMAT (F6.3)                                                       LIVE
  106 FORMAT (3(2X,F6.2))                                                 LIVE
  107 FORMAT (' KNOT ANGLES: ',15F7.2,2(/,13X,15F7.2))                    LIVE
  108 FORMAT (' % AVAILABLE SURFACE MEASURE IN EACH GRADE WITHOUT ',      LIVE
     .  'REPIP: ',5F5.1,' LOG VALUE IS $',F6.2,/,46X,'WITH RERIP: ',      LIVE
     .  5F5.1,' LOG VALUE IS $',F6.2)                                     LIVE
  109 FORMAT (F5.1)                                                       LIVE
  110 FORMAT (2F5.3)                                                      LIVE
  111 FORMAT (' TOTAL SURFACE MEASURE IS',F8.2)                           LIVE
  112 FORMAT (' SURFACE MEASURE PER GRADE IS',5F8.2)                      LIVE
  113 FORMAT (' TOTAL PERCENT YIELD IS',F7.2)                             LIVE
  114 FORMAT (' CORE DEFECT RADIUS ',F6.3,'  LINEAR OFFSET ',F6.3,        LIVE
     .  '  ANGULAR OFFSET ',F6.3)                                        LIVE
  115 FORMAT (' $ YIELD:  HIGH ',F6.2,'  AVERAGE ',F6.2,'  LOW ',F6.2)    LIVE
  116 FORMAT (' REPIP $ YIELD HIGH ',F6.2,' AVERAGE ',F6.2,' LOW ',       LIVE
     .  F6.2)                                                             LIVE
  118 FORMAT (' REPIP SURFACE MEASURE LOSS IS',F6.2,' BOARD FEET')        LIVE
  119 FORMAT (' REPIP $ YIELD:  HIGH ',F6.2,'   AVERAGE ',F6.2,           LIVE
     .  '   LOW ',F6.2)                                                  LIVE
  120 FORMAT (5F10.4)                                                     LIVE
  121 FORMAT (' LIVE SAWING WITH RERIP ',A8)                              LIVE
  122 FORMAT (' LOG PARAMETERS:  LENGTH',F6.1,'  DIA',F6.1,'  TAPER',     LIVE
     .  F6.4,' DEGREES,  LOG VOLUME:',F8.2,' CUBIC FEET')                 LIVE
  123 FORMAT (' ANGLES MEASURED FROM ZERO DEGREES = EAST FOR A ',         LIVE
     .  'VERTICALLY CUTTING SAW.  KNOT TAPER',F6.2)                       LIVE
  124 FORMAT (' CUTTING PARAMETERS:  KERF',F7.4,'  REPIP KERF:',F7.4,     LIVE
     .  '  BOARD THICKNESS:',F5.2)                                       LIVE
  125 FORMAT (' PRICES PER BOARD FOOT  ',5F10.4)                          LIVE
C                                                                         LIVE
C   FORMATS FOR DEVICE 8 (STORAGE MEDIUM)                                 LIVE
C                                                                         LIVE
  200 FORMAT (F6.1,F5.1,I3,3F5.1,F8.2,F6.3,F4.1,F6.2,F5.3,F6.3)           LIVE
  201 FORMAT (3(10F7.2/))                                                 LIVE
  202 FORMAT (5F7.4)                                                      LIVE
  203 FORMAT (I3)                                                         LIVE
  204 FORMAT (5F8.2)                                                      LIVE
  205 FORMAT (10F6.2)                                                     LIVE
      END                                                                 LIVE
```

*** STATEMENT NUMBERS ***

```
    1      *23   253
    2       52   *54
    3       55   *57
    4       70   *72
    5      111  *114
    6     *131   189
    7      140  *145
    8      146  *148
    9      157  *159
   10      135  *184
   11      131  *193
   12      193  *195
   13      121  *197
   14      209  *213
   15      236  *238
   16      101  *240
   17       23  *255
  100      202  *259
  101       43  *260
  103       69  *261
  104       53  *263
  105       36    37    38    56  *264
  106       71  *265
  107      215  *266
  108      216  *267
  109       23    24    26    30    31  *270
  110       25  *271
  111      205  *272
  112      203  *273
  113      217  *274
  114       74  *275
  115      247  *277
  116      248  *278
  118      218  *280
  119      243  *281
  120       42  *283
  121       67  *284
  122       68  *285
  123       73  *287
  124       75  *289
  125       76  *291
  200       77  *295
  201       79    80    81  *296
  202       82  *297
  203      206  *298
  204      207   208   220  *299
  205      210  *300
```

*** VARIABLES ***

```
AMOD      194   196   237   239
ANGLE       8  *53    71    81   158  *194   215  *237
AVGS      *89  *224  *245   247
AVRIP     *93  *232  *244   249
AVRIPS    *92  *225  *246   248
BDLEN       11
BF        *105   131   175   179
BOARDW      11
CANGS     *38    74    77   153  *196  *239
COFSET    *37    74    77   153
CORDIA    *36    48
COREL     153
COPFLG      18  *116   153   179
CPADUS    *48    74    77   153
D           11  *23    61    68    77
DAT          8    47    67
DATE        47
DISTBD      11  *183
F           13  *121
FAS         11  *42    76    82
FLX          8    11  *141
FLY          8    11  *143
FUX          8    11  *142
FUY          8    11  *144
GRADE      167
GRDLFT      10    11
GRDMID      10    11
GRDRGT      10    11
HEIGHT       8  *53    71    80   158
HIGH$     *87  *226   247
HIPIP     *94  *228   249
HIPIP$    *90   228  *230   248
I        *135   153   171   175   179
ID          10    11  *147
INX      *181   201
IROTAT   *201   202   205
J           *52  *53   *55   *56   *70    71    79    80    81  *111   112   113
           *140   141   142   143   144  *146   147  *157   158  *193   194   203
            207  *209   210   211   212   215   216   219  *236   237
K           11  *25    75    77   126
KEPFL      131
KNOT$       11  *30    73    77
KNOTL      158
KTLEN        8  *56    71    79   158
L           11  *24    62    63    68    77
LFTLOC      11
LOG$        11  *31    62    68    77
LORIP     *95  *229   249
LVOL      *63    68    77   210   211   214
MAX       *43    52    55    69    70    77    79    80    81   157   193   215
           236
NBD      *186  *188
NODEFC      10    11  *149
NPG        167   171   175   179
OLD         10  *171   175
ONEC        11  *42    76    82
PEPC         8  *112   175   203   204   207  *210   216   219
PEPCPP       8  *113   179  *211   212   216   219
PPICEL     175
R           11  *126
RAD         62
RB          11  *62    63   126
REPIP      179
RGTLOC      11
RI        *61    62    63
RPKEPF      11  *25    75    77
RPLOSS      11  *115   218   220
RPTOTS   *108  *212   220   220   229   232
SEL         11  *42    76    82
SMALL$    *88  *227   247
SMRIP$    *91   229  *231   248
T           11  *26    75    77   183
TAN         62
THRB        11  *42    76    82
TLOSS       11
TOTS     *107  *204   205   208  *214   217   220
TVAL     *109   175   216   220   224   226   227
TVALRP   *110   179   216   220   225   228   229   230   231
TWOC        11  *42    76    82
V          175   179
WANEL      163
```

Subroutine KERF

```
C   SUBROUTINE 'KERF' CUTS A BOARD FROM THE LOG.  THE BOARD WIDTH IS      KERFL
C   DEFINED AT THE CENTER, AND THE BOARD LENGTH FROM THE BOTTOM           KERFL
C   OF THE LOG                                                            KERFL
C                                                                         KERFL
C                                                                         KERFL
      SUBROUTINE KERFL (*,BF)                                             KERFL
C                                                                         KERFL
      IMPLICIT REAL (K,L)                                                 KERFL
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                        KERFL
      INTEGER ID(22,2),NODEFC(2)                                          KERFL
      COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R          KERFL
     +      /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                             KERFL
C                                                                         KERFL
C                                                                         KERFL
C   ALL BOARDS MUST BE AT LEAST 48 INCHES LONG, 2.5 INCHES WIDE AT        KERFL
C   THE TOP, AND 3 INCHES WIDE AT THE CENTER.  IN ADDITION, THE TOTAL     KERFL
C   AMOUNT OF WANE FROM THE CENTER TO THE TOP IS LIMITED TO 4 INCHES.     KERFL
C   THE BOARD IS CUT BACK IN ONE FOOT INCREMENTS IF THE WIDTH OR WANE     KERFL
C   TESTS FAIL.  IF THE LENGTH TEST FAILS, ANOTHER BOARD IS CUT FROM      KERFL
C   THIS FACE                                                             KERFL
C                                                                         KERFL
C                                                                         KERFL
C    FIND OUTER FACE OF BOARD                                             KERFL
C                                                                         KERFL
      RI = D/2.                                                           KERFL
    1 R = R-T-K                                                           KERFL
      BDLEN = L                                                           KERFL
C                                                                         KERFL
C   IF THIS FACE OF THE LOG IS COMPLETELY CUT, EXIT                       KERFL
C                                                                         KERFL
      IF (R.LT.0.) RETURN1                                                KERFL
      DISTBD = RB-R                                                       KERFL
      POSLEN = R*TAN(RAD(90.-LOG$))                                       KERFL
C                                                                         KERFL
C                                                                         KERFL
C   CHECK FOR BOARDS SHORTER THAN THE LOG DUE TO LOG TAPER                KERFL
C                                                                         KERFL
      IF (POSLEN.LT.BDLEN) BDLEN = POSLEN                                 KERFL
C                                                                         KERFL
C   BOARDS MUST BE AT LEAST 4 FEET LONG                                   KERFL
C                                                                         KERFL
    2 IF (BDLEN.LT.48.) GO TO 1                                           KERFL
C                                                                         KERFL
C   DETERMINE HALF-WIDTH AT MID-LENGTH OF BOARD                           KERFL
C                                                                         KERFL
      RM = D/2.+(L-BDLEN/2.)*TAN(RAD(LOG$))                               KERFL
      IF (DISTBD.GT.RM) GO TO 3                                           KERFL
      BOARDW = SQRT(RM**2-DISTBD**2)                                      KERFL
C                                                                         KERFL
C   BOARD MUST BE AT LEAST 3 INCHES WIDE AT MID-LENGTH                    KERFL
C                                                                         KERFL
      IF (BOARDW.LT.1.5) GO TO 3                                          KERFL
C                                                                         KERFL
C   DETERMINE HALF-WIDTH AT TOP OF BOARD                                  KERFL
C                                                                         KERFL
      RT = RI+(L-BDLEN)*TAN(RAD(LOG$))                                    KERFL
      IF (DISTBD.GT.RT) GO TO 3                                           KERFL
      WT = SQRT(RT**2-DISTBD**2)                                          KERFL
C                                                                         KERFL
C   BOARD MUST BE AT LEAST 2.5 INCHES WIDE AT THE TOP                     KERFL
C                                                                         KERFL
      IF (WT.LT.1.25) GO TO 3                                             KERFL
C                                                                         KERFL
C   LIMIT THE TOTAL WANE TO AVOID GENERATING MORE DEFECTS THAN THE        KERFL
C   GRADING PROGRAM CAN HANDLE.  TOTAL WIDTH OF WANE MUST BE LESS         KERFL
C   THAN 4 INCHES                                                         KERFL
C                                                                         KERFL
      WAN = BOARDW-WT                                                     KERFL
      IF (WAN.GT.2.0) GO TO 3                                             KERFL
C                                                                         KERFL
C   CONVERT BOARD WIDTH AND LENGTH TO EVEN QUARTER INCHES                 KERFL
C                                                                         KERFL
      BOARDW = INT(BOARDW*8.)/8.                                          KERFL
      BDLEN = INT(BDLEN*4.)/4.                                            KERFL
C                                                                         KERFL
C   DEFINE BOARD EDGES IN QUARTER INCH UNITS                              KERFL
C                                                                         KERFL
      FLY(26,1) = BOARDW*8.                                               KERFL
      FLX(26,1) = BDLEN*4.                                                KERFL
      FUX(26,1) = 0.0                                                     KERFL
      FUY(26,1) = 0.0                                                     KERFL
C                                                                         KERFL
C   CALCULATE UNROUNDED BOARD FEET                                        KERFL
C                                                                         KERFL
      BF = BDLEN*BOARDW*2.*T/144.                                         KERFL
      RETURN                                                              KERFL
C                                                                         KERFL
C   CUT BACK BOARD BY ONE FOOT                                            KERFL
C                                                                         KERFL
    3 BDLEN = BDLEN-12.                                                   KERFL
      GO TO 2                                                             KERFL
      END                                                                 KERFL
```

*** STATEMENT NUMBERS ***

1	*26	42								
2	*42	91								
3	47	52	57	62	69	*90				

*** VARIABLES ***

BDLEN	11	*27	*38	42	46	56	*74	79	85	*90
BF	6	*85								
BOARDW	11	*43	51	68	*73	78	85			
D	11	25	46							
DISTBD	11	*32	47	48	57	58				
FLX	9	11	*79							
FLY	9	11	*78							
FUX	9	11	*80							
FUY	9	11	*81							
ID	10	11								
INT	73	74								
K	11	26								
KERFL	6									
KNOT$	11									
L	11	27	46	56						
LOG$	11	33	46	56						
NODEFC	10	11								
POSLEN	*35	38								
R	11	*26	31	32	33					
RAD	73	46	56							
RB	11	32								
RI	*25	56								
RM	*46	47	48							
RT	*56	57	59							
SQRT	48	58								
T	11	26	85							
TAN	73	46	56							
WAN	*68	69								
WT	*58	62	68							

Subroutine WANE

```
 1 C   SUBROUTINE 'WANE' LOCATES WANE DEFECTS ON THE BOARD
 2 C
 3 C
 4       SUBROUTINE WANEL
 5 C
 6 C   THE BOARD EDGE HAS A NEW WANE DEFECT IF THE WIDTH DROPS BY 1/2
 7 C   INCH (1/4 INCH FOR EACH SIDE) FROM THAT AT THE MIDDLE.  THE BOARD
 8 C   IS SYMMETRICAL SO THE WANE DEFECTS OCCUR AT THE SAME PLACE ON
 9 C   BOTH EDGES OF THE BOARD
10 C
11        IMPLICIT REAL (K,L)
12        INTEGER ID(22,2),NODEFC(2)
13        REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)
14        COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R
15               /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
16 C
17 C
18        CON1 = TAN(RAD(LOG$))
19        CON2 = DISTBD**2
20        IF ((RB-SQRT(CON2+BOARDW**2))/CON1.GE.BDLEN) RETURN
21        OLDH = BDLEN*2.
22        V = 0.
23 C
24 C   FIND THE PLACE ALONG THE BOARD WHERE THE HALF-WIDTH HAS DECREASED
25 C   BY 1/4 INCH.  THE DEFECT ENDS HERE AND EXTENDS FROM THE END OF THE
26 C   LAST WANE DEFECT (OR FROM THE MIDDLE OF THE BOARD).
27 C
28      1 V = V+0.25
29        SQR = SQRT(CON2+(BOARDW-V)**2)
30        H = INT(AMIN1((RB-SQR)*4./CON1,BDLEN*4.))
31        NODEFC(1) = NODEFC(1)+1
32        M = NODEFC(1)
33 C
34 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)
35 C
36        IF (M.GT.22) GO TO 2
37 C
38 C   SAVE WANE COORDINATES FOR GRADING PROGRAM
39 C
40        FIY(M,1) = V*4.+1
41        FLY(M,1) = 0.
42        FUX(M,1) = H
43        FLX(M,1) = OLDH
44        ID(M,1) = 5
45 C
46 C   SINCE THE BOARD IS SYMMETRICAL, USE THE PREVIOUSLY GENERATED HEIGHT
47 C   FOR THE WANE DEFECTS ON THE OTHER EDGE OF THE BOARD
48 C
49      2 NODEFC(1) = NODEFC(1)+1
50        M = NODEFC(1)
51        IF (M.GT.22) GO TO 3
52        FUY(M,1) = BOARDW*8.
53        FLY(M,1) = BOARDW*8.-V*4.-1.
54        FUX(M,1) = H
55        FLX(M,1) = OLDH
56        ID(M,1) = 5
57 C
58 C   WHEN THE DEFECT EXTENDS TO THE END OF THE BOAPD, EXIT
59 C
60      3 IF (H.GE.BDLEN*4.) RETURN
61 C
62 C   THE NEXT WANE DEFECT BEGINS WHERE THIS ONE ENDS
63 C
64        OLDH = H
65        GO TO 1
66        RETURN
67        END
```

WANEL

*** STATEMENT NUMBERS ***

1	*28	65	
2	36	*49	
3	51	*60	

*** VARIABLES ***

AMIN1	30											
BDLEN	14	20	21	30	60							
BOARDW	14	20	29	52	53							
CON1	*18	20	30									
CON2	*19	20	29									
D	14											
DISTBD	14	19										
FLX	13	14	*43	*55								
FLY	13	14	*41	*53								
FUX	13	14	*42	*54								
FUY	13	14	*40	*52								
H	*30	42	54	60	64							
ID	12	14	*44	*56								
INT	30											
K	14											
KNOT$	14											
L	14											
LOG$	14	18										
M	*32	36	40	41	42	43	44	*58	51	52	53	54
	55	56										
NODEFC	12	14	*31	32	*49	50						
OLDH	*21	43	55	*64								
R	14											
RAD	18											
RB	14	20	30									
SQR	*29	30										
SQRT	20	29										
T	14											
TAN	18											
V	*22	*28	29	40	53							
WANEL	4											

Subroutine KNOT

```
      SUBROUTINE 'KNOT' LOCATES THE KNOT DEFECTS ON THE BOARD FACE.
      ANGLES ARE MEASURED CLOCKWISE WITH 0 DEGREES DEFINED AS THE
      LINE FROM THE CENTER OF THE LOG PERPENDICULAR TO THE BOARD FACE

        SUBROUTINE KNOTL (KHIGH,KLEN,KTANG$)

        IMPLICIT REAL (K,L)
        INTEGER ID(22,2),NODEFC(2)
        REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)
        COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
               /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R

      SEE IF THE KNOT IS LONG ENOUGH TO REACH THE BOARD FACE

        IF (KLEN.LT.DISTBD) RETURN

      CALCULATE KNOT DEFECT HALF-LENGTH AS PROJECTED ON THE FACE, LOG
      RADIUS AT KNOT HEIGHT, AND BOARD HALF-WIDTH ANGLE

        DY = DISTBD*TAN(RAD(KNOT$))
        LRADUS = RB-KHIGH*TAN(RAD(LOG$))
        BDWID$ = DEG(ATAN(BOARDW/DISTBD))

      THE KNOT EFFECTIVELY ENDS AT THE OUTER EDGE OF THE LOG

        IF (KLEN.GT.LRADUS) KLEN = LRADUS

      SINCE THE LOG IS TAPERED, THE OUTER BOARDS MAY NOT BE THE FULL LOG
      LENGTH, SO KNOTS ABOVE THE END OF THE BOARD ARE NOT CONSIDERED

        IF (LRADUS.LT.DISTBD) RETURN

      ANGLE OF ROTATION PUTS KNOT COMPLETELY OUTSIDE BOARD

        IF ((KTANG$.GT.180.).AND.((KTANG$+KNOT$).LT.(360.-BDWID$))) RETURN
        IF ((KTANG$.LE.180.).AND.((KTANG$-KNOT$).GT.BDWID$)) RETURN

      FIND THE QUADRANT IN WHICH THE KNOT LIES (ASSUME QUADRANT ONE)

      QUADRANT TWO

        IF ((KTANG$.LT.180.).AND.((KTANG$+KNOT$).GT.BDWID$)) GO TO 3

      QUADRANT THREE

        IF ((KTANG$.GE.180.).AND.((KTANG$-KNOT$).LT.(360.-BDWID$)))
          GO TO 4

      QUADRANT FOUR

        IF (KTANG$.GT.270.) GO TO 5


      QUADRANT ONE

      SEE IF KNOT CENTER IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES

        IF (KTANG$-KNOT$.LT.0.) GO TO 2

      CALCULATE DISTANCE TO FACE ALONG BOTH SIDES OF KNOT

        ANGBD1 = DISTBD/COS(RAD(KTANG$-KNOT$))
        ANGBD2 = DISTBD/COS(RAD(KTANG$+KNOT$))

      KNOT IS NOT LONG ENOUGH TO REACH FACE

        IF (KLEN.LT.ANGBD1) RETURN

      FIND INTERSECTION OF NEAR SIDE OF KNOT AND FACE

        XR = BOARDW-DISTBD*TAN(RAD(KTANG$-KNOT$))
        IF (KLEN.LT.ANGBD2) GO TO 1

      FAR SIDE OF KNOT REACHES FACE

          XL = BOARDW-DISTBD*TAN(RAD(KTANG$+KNOT$))
          FULWID = (XR-XL)/2.
          GO TO 8

      FAR SIDE OF KNOT DOES NOT REACH FACE

    1     XL = SQRT(KLEN**2-DISTBD**2)
          FULWID =
         . DISTBD*TAN(RAD(KTANG$+KNOT$))-DISTBD*TAN(RAD(KTANG$-KNOT$))
          GO TO 8

      KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES

    2   XL = AMIN1(SQRT(KLEN**2-DISTBD**2),DISTBD*TAN(RAD(KNOT$+KTANG$)))
          XL = BOARDW-XL
          XR = AMIN1(SQRT(KLEN**2-DISTBD**2),DISTBD*TAN(RAD(KNOT$-KTANG$)))
          XR = BOARDW+XR

      KNOTS NEARLY PERPENDICULAR HAVE THEIR WIDTH ESTIMATED BY THEIR
      LENGTH

          FULWID = DY*2.
          GO TO 8

      QUADRANT TWO

    3 ANGBD1 = DISTBD/COS(RAD(KTANG$-KNOT$))

      TOO SHORT TO REACH FACE

          IF (KLEN.LT.ANGBD1) RETURN
          XR = BOARDW-SQRT(ANGBD1**2-DISTBD**2)
          XL = BOARDW-SQRT(KLEN**2-DISTBD**2)
          IF ((KTANG$+KNOT$).GE.89.5)
         .  FULWID = LRADUS-DISTBD*TAN(RAD(KTANG$-KNOT$))
          IF ((KTANG$+KNOT$).LT.89.5)
         .  FULWID = AMIN1(LRADUS,DISTBD*TAN(RAD(KTANG$+KNOT$)))
         .    -DISTBD*TAN(RAD(KTANG$-KNOT$))
          GO TO 8

      QUADRANT THREE

    4 ANGBD1 = DISTBD/COS(RAD(360.-KTANG$-KNOT$))
          IF (KLEN.LT.ANGBD1) RETURN
          XR = BOARDW+SQRT(KLEN**2-DISTBD**2)
          XL = BOARDW+SQRT(ANGBD1**2-DISTBD**2)
          IF ((KTANG$-KNOT$).LE.270.5)
         .  FULWID = LRADUS-DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
          IF ((KTANG$-KNOT$).GT.270.5)
         .  FULWID = AMIN1(LRADUS,DISTBD*TAN(RAD(360.-KTANG$+KNOT$)))
         .    -DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
          GO TO 8

      QUADRANT FOUR

    5 IF (360.-KTANG$-KNOT$.LT.0.) GO TO 7
          ANGBD1 = DISTBD/COS(RAD(360.-KTANG$-KNOT$))
          ANGBD2 = DISTBD/COS(RAD(360.-KTANG$+KNOT$))
          IF (KLEN.LT.ANGBD1) RETURN
          XL = BOARDW+DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
          IF (KLEN.LT.ANGBD2) GO TO 6

      FAR SIDE OF KNOT REACHES FACE

          XR = BOARDW+DISTBD*TAN(RAD(360.-KTANG$+KNOT$))
          FULWID = (XR-XL)/2.
          GO TO 8

      FAR SIDE OF KNOT DOES NOT REACH FACE

    6 XR = BOARDW+SQRT(KLEN**2-DISTBD**2)
          FULWID = DISTBD*TAN(RAD(360.-KTANG$+KNOT$))
         . -DISTBD*TAN(RAD(360.-KTANG$-KNOT$))
          GO TO 8
```

```
154 C   THE KNOT IS WITHIN ONE KNOT HALF-ANGLE OF 0 DEGREES                    KNOTL
155 C                                                                          KNOTL
156       ? XL = AMIN1(SQRT(KLEN**2-DISTBD**2),                                KNOTL
157      .  DISTBD*TAN(RAD(TANG$+KNOT$-360.)))                                 KNOTL
158         XL = BOARDW-XL                                                     KNOTL
159         XR = AMIN1(SQRT(KLEN**2-DISTBD**2),                                KNOTL
160      .  DISTBD*TAN(RAD(360.-KTANG$+KNOT$)))                                KNOTL
161         XR = BOARDW+XP                                                     KNOTL
162         FULWID = D/2.                                                      KNOTL
163 C                                                                          KNOTL
164 C   IF A KNOT COMPLETELY INTERSECTS THE FACE, ITS LENGTH IS EXACTLY AS      KNOTL
165 C   MEASURED ON THE FACE.  OTHERWISE, ITS LENGTH IS ESTIMATED AS A          KNOTL
166 C   PROPORTION OF ITS PROJECTED LENGTH                                      KNOTL
167 C                                                                          KNOTL
168         DY = AMIN1(DY,D/(XP-XL+2.*FULWID))                                 KNOTL
169         YB = KHIGH-DY                                                      KNOTL
170         YT = KHIGH+DY                                                      KNOTL
171 C                                                                          KNOTL
172 C   DEFECT LOCATIONS FOUND.  CHECK THAT THEY DO NOT EXTEND BEYOND THE      KNOTL
173 C   BOARD EDGES AND CONVERT TO QUARTER INCH UNITS FOR THE GRADING          KNOTL
174 C   PROGRAM                                                                KNOTL
175 C                                                                          KNOTL
176         XL = AMAX0(0.,INT(XL*4.))                                          KNOTL
177         XP = AMIN0(INT(BOARDW*8.),INT(XP*4.+1.))                           KNOTL
178         YB = AMAX0(0.,INT(YB*4.))                                          KNOTL
179         YT = AMIN0(INT(BDLEN*4.),INT(YT*4.+1.))                            KNOTL
180 C                                                                          KNOTL
181 C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)     KNOTL
182 C                                                                          KNOTL
183         NODEFC(1) = NODEFC(1)+1                                            KNOTL
184         IF (NODEFC(1).GT.22) RETURN                                        KNOTL
185 C                                                                          KNOTL
186 C   SAVE KNOT COORDINATES FOR GRADING PROGRAM                              KNOTL
187 C                                                                          KNOTL
188         I=NODEFC(1)+1                                                      KNOTL
189         FL(NODEFC(1),1) = XL                                               KNOTL
190         FL(NODEFC(1),2) = YB                                               KNOTL
191         FU(NODEFC(1),1) = XP                                               KNOTL
192         FU(NODEFC(1),2) = YT                                               KNOTL
193         RETURN                                                             KNOTL
194         END                                                                KNOTL
```

```
COS          65   66  104  120  134  135
D            11
DEG          24
DISTBD       11   17   22   24   33   65   66   74   78   84   85   91
             95  104  109  110  111  113  120  122  123  126  134  135
            137  142  148  149  156  159
DY          *22   99  162 *168  169  170
FLX          10   11 *190
FLY          10   11 *189
FULWID      *79  *85  *99 *111 *113 *126 *143 *149 *162  168
FUX          10   11 *192
FUY          10   11 *191
ID            9   11 *188
INT         176  177  178  179
K            11
KHIGH         6   23  169  170
KLEN          6   17 *26   70   75   84   91   93  100  110  121  122
            136  138  148  156  159
KNOT$        11   22   37   38   45   49   61   65   66   74   78   85
             91   93  104  111  113  120  126  133  134  135  137  142
            142  156  159
KNOTL         1
KTANG$        6   37   38   45   49   54   61   65   66   74   78   85
             91   93  104  111  113  120  126  133  134  135  137  142
            149  156  159
L            11
LOG$         11   23
LRADUS      *25   28   33  111  113  126
NODEFC       9   11 *183  184  188  189  190  191  192
P            11
PAD          29   35   65   66   74   78   85   91   93  104  111  113
            120  126  134  135  137  142  149  156  157
PI           11   29
SQRT         91   91   92  109  110  122  123  148  156  159
T            11
TAN          29   29   34   70   85   91   93  111  119  126  137  141
            149  156  159
XL          *75   79  *84  *91  *92 *110 *125 *137  143 *156 *158  160
            *170  189
XP          *71   76  *97  *91 *109 *120 *142  143 *148 *159 *161  163
            *167  191
YB          *72  *173  180
YT          *73  *176  182
```

*** STATEMENT NUMBERS ***

```
1        75   *91
2        61   *91
3        45  *104
4        49  *120
5        51  *133
6       138  *148
7       177  *156
8        80    87   100   116   129   144   151  *169
```

*** VARIABLES ***

```
AMAX0       176  178
AMIN0       177  179
AMIN1        91   93   113   126   156   159   168
ANGBD1      *55   70  *104   108   139  *120   121   123  *134   136
ANGBD2      *67   75  *135   138
ATAN         29
BDLEN        11   179
BDWIDS      *24   37    38    45    49
BOARDW       11   24    71    78    84    92    94   103   110   122   123   137
             141  148   158   161   177
```

Subroutine CORE

```
      C   SUBROUTINE 'CORE' LOCATES THE CORE DEFECT ON THE BOARD FACE          COREL
      C                                                                        COREL
      C                                                                        COREL
            SUBROUTINE COREL (RADUS,COFSET,CANG$,CORFLG,I)                     COREL
      C                                                                        COREL
            IMPLICIT REAL (K,L)                                              COREL
            INTEGER ID(22,2),NODEFC(2),CORFLG                                COREL
            REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                     COREL
            COMMON /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R       COREL
                   /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                         COREL
      C                                                                        COREL
      C                                                                        COREL
      C   FIND DISTANCE TO THE BOARD FACE FROM THE CENTER OF THE CORE. EXIT    COREL
      C   IF THE BOARD FACE IS BEYOND THE CORE RADIUS                          COREL
      C                                                                        COREL
            TDIST = DISTBD-COFSET*COS(RAD(CANG$))                            COREL
            IF (RADUS.LE.TDIST) RETURN                                       COREL
            NODEFC(I) = NODEFC(I)+1                                          COREL
      C                                                                        COREL
      C   LIMIT NUMBER OF DEFECTS TO MAXIMUM ALLOWED BY GRADING PROGRAM (22)  COREL
      C                                                                        COREL
            IF (NODEFC(I).GT.22) RETURN                                      COREL
      C                                                                        COREL
      C   LOCATE THE CENTER POINT OF THE INTERSECTION OF THE BOARD FACE AND    COREL
      C   THE CORE DEFECT.  CALCULATE THE DISTANCE ON THE BOARD FROM THE       COREL
      C   CENTER POINT TO THE EDGES OF THE CORE DEFECT.  THE CORE DEFECT       COREL
      C   IS NOT TAPERED, SO IT WILL EXTEND THE FULL LENGTH OF THE BOARD       COREL
      C                                                                        COREL
            CONST = SQRT(RADUS**2-TDIST**2)                                  COREL
            TBDCTR = COFSET*SIN(RAD(CANG$))                                  COREL
            XR = BOARDW+CONST-TBDCTR                                         COREL
            XL = BOARDW-CONST-TBDCTR                                         COREL
      C                                                                        COREL
      C   SAVE CORE DEFECT COORDINATES FOR GRADING PROGRAM                    COREL
      C                                                                        COREL
            FUX(NODEFC(I),I) = INT(BDLEN*4.)                                 COREL
            FLX(NODEFC(I),I) = 0.0                                           COREL
            FUY(NODEFC(I),I) = AMIN0(INT(BOARDW*8.),INT(XR*4.+1.))           COREL
            FLY(NODEFC(I),I) = AMAX0(0,INT(XL*4.))                           COREL
            ID(NODEFC(I),I) = 7                                              COREL
      C                                                                        COREL
      C   IF A CORE DEFECT IS FOUND ON THE OUTER FACE OF A BOARD, THE BOARD    COREL
      C   WILL BE REPIPPED IN AN ATTEMPT TO INCREASE ITS GRADE AND VALUE       COREL
      C                                                                        COREL
            IF (I.EQ.1) CORFLG = 1                                           COREL
            RETURN                                                           COREL
            END                                                              COREL
```

*** VARIABLES ***

AMAX0	39			
AMIN0	38			
BDLEN	9	36		
BOARDW	9	31	32	38
CANG$	4	16	30	
COFSET	4	16	30	
CONST	*22	31	32	
COREL	1			
CORFLG	1	7	*45	
DEG	16			
DISTBD	9	16		
FLX	8	9	*37	
FLY	8	9	*39	
FUX	8	9	*36	
FUY	8	9	*38	
I	4	45		
ID	7	9	*40	
INT	38	38	39	
K	9			
KNOT$	9			
L	9			
LOG$	9			
NODEFC	7	9	*18	22	36	37	38	39	40
R	9			
RAD	17	30		
RB	9			
SIN	30			
SQRT	29			
T	9			
TBDCTR	*30	31	32	
TDIST	*16	17	29	
XL	*32	39		
XR	*31	38		

Subroutine GRADE

```
 1 C   SUBROUTINE 'GRADE' CALLS THE U.S. FOREST PRODUCTS LABORATORY        GPADE
 2 C   GRADING PROGRAM                                                     GPADE
 3 C                                                                       GRADE
 4 C                                                                       GPADE
 5       SUBROUTINE GRADE (NPG)                                            GPADE
 6 C                                                                       GRADE
 7       INTEGER ID(22,2),NODEFC(2),IX(22)                                 GRADE
 8       REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2)                      GRADE
 9       COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID                          GRADE
10 C                                                                       GRADE
11 C                                                                       GRADE
12       M = NODEFC(1)                                                     GRADE
13       IF (M.EQ.0) GO TO 2                                               GRADE
14       IF (M.GT.22) GO TO 3                                              GPADE
15       DO 1 J=1,M                                                        GPADE
16         IX(J) = ID(J,1)                                                 GRADE
17     1 CONTINUE                                                          GRADE
18     2 NPG = 1                                                           GPADE
19       CALL GRD (M,IX,NPG,SM)                                            GPADE
20       RETURN                                                            GPADE
21 C                                                                       GPADE
22 C   IF NUMBER OF DEFECTS IS MORE THAN GRADING PROGRAM CAN HANDLE.       GPADE
23 C   THE GRADE IS 3A/3B                                                  GPADE
24 C                                                                       GPADE
25     3 WRITE (6,100)                                                     GPADE
26   100 FORMAT (' ',      DEFECT LIMIT EXCEEDED')                        GPADE
27       NPG = 5                                                           GPADE
28       RETURN                                                            GPADE
29       END                                                               GPADE
```

*** STATEMENT NUMBERS ***

```
     1        15   *17
     2        17   *18
     3        14   *25
   100        25   *26
```

*** VARIABLES ***

```
FLX          8     9
FLY          8     9
FUX          8     9
FUY          8     9
GPADE        5
GRD         19
ID           7     9    16
IX           7   *16    19
J           *15    16
M           *12    13    14    15    19
NODEFC       7     9    12
NPG          5   *18    19   *27
SM          19
```

Subroutine PRICE

```
 1 C   SUBROUTINE 'PPICE' DETERMINES THE BOARD GRADE BASED ON THE GRADES   PRICEL
 2 C   OF BOTH SIDES (OLD,NPG) AND CALCULATES THE BOARD VALUE               PRICEL
 3 C                                                                       PRICEL
 4 C                                                                       PRICEL
 5       SUBROUTINE PRICEL (BF,OLD,NPG,TVAL,PERC,V)                        PRICEL
 6 C                                                                       PRICEL
 7       INTEGER OLD                                                       PPICEL
 8       REAL PERC(5)                                                      PRICEL
 9       COMMON /PRICE/ FAS,SEL,ONEC,TWOC,THRB                             PRICEL
10 C                                                                       PPICEL
11 C                                                                       PRICEL
12 C   IS EITHER SIDE BELOW GRADE?                                         PRICEL
13 C                                                                       PPICEL
14       IF (OLD.EQ.6.OR.NPG.EQ.6) RETURN                                  PPICEL
15                                                                         PPICEL
16 C   DETERMINE THE BOARD GRADE                                           PRICEL
17 C                                                                       PRICEL
18       IF (OLD.EQ.5.OR.NPG.EQ.5) GO TO 3                                 PRICEL
19       IF (OLD.EQ.2.OR.NPG.EQ.2) GO TO 1                                 PRICEL
20       IF (OLD.EQ.NPG) GO TO 4                                           PRICEL
21       NPG = MAX0(OLD,NPG)                                               PRICEL
22       IF (NPG.EQ.4) GO TO 8                                             PRICEL
23       NPG = 2                                                           PRICEL
24       GO TO 6                                                           PRICEL
25     1 IF (OLD.EQ.4.OR.NPG.EQ.4) GO TO 2                                 PRICEL
26       NPG = 3                                                           PRICEL
27       GO TO 4                                                           PRICEL
28     2 NPG = 4                                                           PRICEL
29       GO TO 4                                                           PRICEL
30     3 NPG = 5                                                           PRICEL
31     4 GO TO (5,6,7,8,9), NPG                                            PPICEL
32 C                                                                       PPICEL
33 C   AND CALCULATE THE BOARD VALUE                                       PRICEL
34 C                                                                       PRICEL
35     5 V = BF*FAS                                                        PRICEL
36       GO TO 10                                                          PPICEL
37     6 V = BF*SEL                                                        PPICEL
38       GO TO 10                                                          PRICEL
39     7 V = BF*ONEC                                                       PRICEL
40       GO TO 10                                                          PPICEL
41     8 V = BF*TWOC                                                       PRICEL
42       GO TO 10                                                          PRICEL
43     9 V = BF*THRB                                                       PRICEL
44 C                                                                       PRICEL
45 C   INCREASE SURFACE MEASURE IN THIS GRADE AND THE TOTAL LOG VALUE      PRICEL
46 C                                                                       PRICEL
47    10 PERC(NPG) = BF+PERC(NPG)                                          PRICEL
48       TVAL = TVAL+V                                                     PRICEL
49       RETURN                                                            PRICEL
50       END                                                               PRICEL
```

*** STATEMENT NUMBERS ***

```
 1        19   *25
 2        25   *28
 3        18   *30
 4        20    27    29   *31
 5        31   *35
 6        24    31   *37
 7        31   *39
 8        22    31   *41
 9        31   *43
10        36    38    40    42   *47
```

**** VARIABLES ****

BF	5	35	37	39	41	43	47					
FAS	9	35										
MAXB	21											
NPG	5	14	18	19	20	*21	22	*23	25	*26	*28	*30
	31	47										
OLD	5	7	14	18	19	20	21	25				
ONEC	9	39										
PERC	5	8	*47									
PRICEL	5											
SEL	9	37										
THRB	9	43										
TVAL	5	*48										
TUDC	9	41										
V	5	*35	*37	*39	*41	*43	48					

Subroutine RERIP

```
C   SUBROUTINE 'RERIP' DETERMINES WHETHER RIPPING A BOARD INTO TWO OR
C   THREE PIECES WILL IMPROVE ITS VALUE WHEN A CORE DEFECT IS FOUND ON
C   THE OUTER FACE (CORFLG = 1) AND THE GRADE IS BELOW SELECTS.  THE
C   CORE DEFECT BOUNDRIES ON THE OUTER FACE DETERMINE THE RIP LINES
C
C
      SUBROUTINE RERIP (TVALRP,PERCRP,NPG,V,CORFLG,I,BF)
C
      IMPLICIT REAL (K,L)
      INTEGER CORFLG,ID(22,2),NODEFC(2),GRDRGT,GRDMID,RGRADE,GRDLFT,
     .        LGRADE
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),PERCRP(5),DUMYRP(5)
      COMMON /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
     .       /FORRIP/ RPLOSS,RPKERF,LFTLOC,RGTLOC,GRDRGT,GRDLFT,GRDMID,
     .                TLOSS
     .       /BOARD/ L,D,K,T,LOG$,RB,DISTBD,BDLEN,BOARDW,KNOT$,R
C
C
C   CONVERT BOARD WIDTH TO INCHES
C
      WIDTH = FLY(26,1)/4.
      IF (I.EQ.2) GO TO 8
C
C
C   OUTER FACE OF BOARD TO BE RIPPED...
C
C   IF NO CORE DEFECT, DO NOTHING
C
      TLOSS = 0.0
      IF (CORFLG.EQ.0) RETURN
C
C  FIND THE CORE DEFECT
C
      M = NODEFC(1)
      INDEX = 1
      DO 1 J=1,M
        IF (ID(J,1).EQ.7) INDEX = J
    1 CONTINUE
      IF (ID(INDEX,1).NE.7) GO TO 12
C
C   DEFINE RIP LOCATIONS IN QUARTER INCH UNITS
C
      LFTLOC = FLY(INDEX,1)
      RGTLOC = FUY(INDEX,1)
C
C   GRADE OF MIDDLE PIECE ASSUMED 3A/3B. OTHERS FAS
C
      GRDMID = 5
      RGRADE = 1
      LGRADE = 1
C
C   CALCULATE PIECE WIDTHS.  IF EITHER SIDE IS TOO SMALL TO MAKE LUMBER
C   (3"), ADD IT TO THE MIDDLE PIECE
C
      WIDRGT = WIDTH-RGTLOC/4.
      IF (WIDRGT-3.) 2,3,3
    2 RGTLOC = WIDTH*4.+RPKERF*4.
      RGRADE = 6
    3 WIDLFT = LFTLOC/4.
      IF (WIDLFT-3.) 4,5,5
    4 LFTLOC = -RPKERF*4.
      LGRADE = 6
    5 WIDMID = (RGTLOC-LFTLOC)/4.-2.*RPKERF
      IF (WIDMID-3.) 6,7,7
C
C   IF MIDDLE IS TOO SMALL TO MAKE LUMBER, ADD ITS SURFACE MEASURE TO
C   THE RIP LOSS
C
    6 TLOSS = AMAX1(0.,(WIDMID*BDLEN*T/144.))
      GRDMID = 6
C
C   GET GRADE OF OUTER FACES
C
    7 CALL RIP (RGRADE,LGRADE)
C
```

```
C   SAVE OUTER FACE GRADES
C
      GRDRGT = RGRADE
      GRDLFT = LGRADE
      RETURN
C
C
C   INNER FACE OF BOARD TO BE RIPPED...
C
    8 RIPVAL = 0.
      OLDVAL = V
      DO 9 I=1,5
        DUMYRP(J) = 0.
    9 CONTINUE
C
C   IF BOARD IS FAS OR SELECTS,
C
      IF (NPG.EQ.1.OR.NPG.EQ.2) GO TO 11
C
C   OR IF NO OUTER FACE CORE DEFECT FOUND, DO NOT RIP
C
      IF (CORFLG.EQ.0) GO TO 11
C
C   ANY PIECE THAT IS TOO SMALL TO MAKE LUMBER IS BELOW GRADE
C
      IF (GRDRGT.EQ.6) RGRADE = 6
      IF (GRDLFT.EQ.6) LGRADE = 6
C
C   GET GRADE OF INNER FACES
C
      CALL PIP (RGRADE,LGRADE)
C
C   CALCULATE SURFACE MEASURE OF EACH PIECE
C
      WIDMID = (RGTLOC-LFTLOC)/4.-2.*RPKERF
      SMMID = WIDMID*BDLEN*T/144.
      SMRGT = (WIDTH-RGTLOC/4.)*BDLEN*T/144.
      SMLFT = LFTLOC/4.*BDLEN*T/144.
C
C   DETERMINE GRADE AND VALUE OF EACH PIECE
C
      IOLDRT = GRDRGT
      IOLDLT = GRDLFT
      IMGRD = GRDMID
      CALL PRICEL (SMRGT,IOLDRT,RGRADE,RIPVAL,DUMYPP,V)
      CALL PRICEL (SMLFT,IOLDLT,LGRADE,RIPVAL,DUMYRP,V)
      CALL PRICEL (SMMID,IMGRD,IMGRD,RIPVAL,DUMYPP,V)
C
C   IF REPIPPING DOES NOT IMPROVE THE VALUE, DO NOT DO IT
C
      IF (RIPVAL.LE.OLDVAL) GO TO 11
C
C   OTHERWISE, INCREASE RERIP VALUES
C
      TVALRP = TVALRP+RIPVAL
      DO 10 J=1,5
        PERCRP(J) = PERCRP(J)+DUMYRP(J)
   10 CONTINUE
C
C   INCREASE LOSS DUE TO REPIPPING
C
      CORFLG = 0
      RPLOSS = RPLOSS+TLOSS
      IF (RGRADE.NE.6) RPLOSS = RPLOSS+RPKERF*BDLEN*T/144.
      IF (LGRADE.NE.6) RPLOSS = RPLOSS+RPKERF*BDLEN*T/144.
      RETURN
C
C   BOARD IS NOT TO BE RIPPED
C
   11 PERCRP(NPG) = PERCRP(NPG)+BF
      TVALRP = TVALRP+OLDVAL
   12 CORFLG = 0
      RETURN
      END
```

RERIP

*** STATEMENT NUMBERS ***

1	36	*38			
2	56	*57			
3	56	*59			
4	60	*61			
5	60	*63			
6	64	*69			
7	64	*74			
8	22	*85			
9	87	*89			
10	131	*133			
11	93	97	126	*145	
12	39	*147			

*** VARIABLES ***

AMAX1	69							
BDLEN	13	69	111	112	113	139	140	
BF	7	145						
BOARDW	13							
CORFLG	7	10	38	97	*137	*147		
D	13							
DISTBD	13							
DUMYRP	12	*88	120	121	122	132		
FLX	12	13						
FLY	12	13	21	43				
FUX	12	13						
FUY	13	13	44					
GRDLFT	10	13	*79	102	118			
GRDMID	10	13	*48	*70	119			
GRDRGT	10	13	*78	101	117			
I	7	22						
ID	10	13	37	39				
IMGRD	*119	122						
INDEX	*35	*37	39	43	44			
IOLDLT	*118	121						
IOLDRT	*117	120						
J	*36	37	*87	88	*131	132		
K	13							
KNOT$	13							
L	13							
LFTLOC	13	*43	59	*61	63	110	113	
LGRADE	10	*50	*62	74	79	*102	106	121	140
LOG$	13							
M	*34	36						
NOLEFC	10	13	34					
NPG	7	93	145					
OLDVAL	*86	126	146					
PERCRP	7	12	*132	*145				
PRICEL	120	121	122					
R	13							
RB	13							
RERIP	7							
RGRADE	10	*49	*50	74	78	*101	106	120	139
RGTLOC	13	*44	55	*57	63	110	112	
RIP	74	106						
RIPVAL	*85	120	121	122	126	130		
RPKERF	13	57	61	63	110	139	140	
RPLOSS	13	*138	*139	*140				
SMLFT	*113	121						
SMMID	*111	122						
SMRGT	*112	120						
T	13	69	111	112	113	139	140	
TLOSS	13	*29	*69	138				
TVALRP	7	*130	*146					
V	7	86	120	121	122			
WIDLFT	*59	60						
WIDMID	*63	64	69	*110	111			
WIDRGT	*55	56						
WIDTH	*21	55	57	112				

Subroutine RIP

```
C   SUBROUTINE 'RIP' RIPS THE FACE INTO TWO OR THREE PIECES AND GETS
C   THE GRADE OF EACH PIECE
C
C
      SUBROUTINE RIP (RGRADE,LGRADE)
C
      IMPLICIT REAL (K,L)
      INTEGER ID(22,2),NODEFC(2),ITYPE(22),RGRADE,LGRADE,GRDRGT,GRDLFT,
     .        GRDMID
      REAL FLX(26,2),FLY(26,2),FUX(26,2),FUY(26,2),LX(22),LY(22),UX(22),
     .     UY(22)
      COMMON /FORRIP/ RPLOSS,RPKERF,LFTLOC,RGTLOC,GRDRGT,GRDLFT,GRDMID,
     .                TLOSS
     .      /DEFEC/ NODEFC,FLX,FLY,FUX,FUY,ID
C
C
C   SAVE BOARD WIDTH
C
      WIDTH = FLY(26,1)
C
C   SAVE TYPE, LOCATION, AND NUMBER OF DEFECTS
C
      DO 1 J=1,22
        ITYPE(J) = ID(J,1)
        UX(J) = FUX(J,1)
        UY(J) = FUY(J,1)
        LX(J) = FLX(J,1)
        LY(J) = FLY(J,1)
    1 CONTINUE
      M = NODEFC(1)
C
C   IF EITHER PIECE IS BELOW GRADE, NOTHING IS DONE TO THAT PIECE
C
C   RIGHT (UPPER) PIECE
C
      IF (RGRADE.EQ.6) GO TO 3
C
C   LOCATE DEFECTS IN THIS PIECE, IGNORING THOSE WHICH LIE BELOW THE
C   RIP LINE
C
      N = 0
      DO 2 J=1,M
        IF (UY(J).LE.RGTLOC) GO TO 2
        N = N+1
        FLY(N,1) = UY(J)-RGTLOC
        FLY(N,1) = AMAX1(0.,(LY(J)-RGTLOC))
        FUX(N,1) = UX(J)
        FLX(N,1) = LX(J)
        ID(N,1) = ITYPE(J)
    2 CONTINUE
C
C   DETERMINE PIECE WIDTH; NUMBER OF DEFECTS
C
      FLY(26,1) = WIDTH-RGTLOC
      NODEFC(1) = N
C
C   GRADE RIGHT (UPPER) PIECE
C
      CALL GRADE (RGRADE)
C
C   LEFT (LOWER) PIECE
C
    3 IF (LGRADE.EQ.6) GO TO 5
C
C   LOCATE DEFECTS IN THIS PIECE, IGNORING THOSE WHICH LIE ABOVE THE
C   RIP LINE
C
      N = 0
      DO 4 J=1,M
        IF (LY(J).GE.LFTLOC) GO TO 4
        N = N+1
        FUY(N,1) = AMIN1(LFTLOC,UY(J))
        FLY(N,1) = LY(J)
        FUX(N,1) = UX(J)
        FLX(N,1) = LX(J)
        ID(N,1) = ITYPE(J)
    4 CONTINUE
C
C   DETERMINE PIECE WIDTH; NUMBER OF DEFECTS
C
      FLY(26,1) = LFTLOC
      NODEFC(1) = N
C
C   GRADE LEFT (LOWER) PIECE
C
      CALL GRADE (LGRADE)
C
C   RESTORE TYPE, LOCATION, AND NUMBER OF DEFECTS; BOARD WIDTH
C
    5 DO 6 J=1,22
        ID(J,1) = ITYPE(J)
        FLY(J,1) = LY(J)
        FUY(J,1) = UY(J)
        FLX(J,1) = LX(J)
        FUX(J,1) = UX(J)
    6 CONTINUE
      NODEFC(1) = M
      FLY(26,1) = WIDTH
      RETURN
      END
```

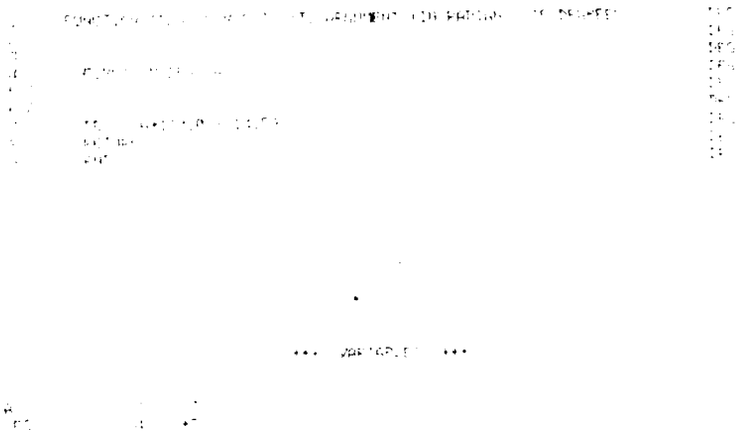
*** STATEMENT NUMBERS ***

1	23	*29	
2	42	43	*50
3	36	*63	
4	69	70	*77
5	63	*90	
6	90	*96	

*** VARIABLES ***

AMAX1	46											
AMIN1	72											
FLX	10	12	27	*48	*75	*94						
FLY	10	12	19	28	*46	*54	*73	*81	*92	*98		
FUX	10	12	25	*47	*74	*95						
FUY	10	12	26	*45	*72	*93						
GRADE	59	86										
GRDLFT	8	12										
GRDMID	8	12										
GRDRGT	8	12										
ID	8	12	24	*49	*76	*91						
ITYPE	8	*24	49	76	91							
J	*23	24	25	26	27	28	42	43	45	46	47	48
	49	*69	70	72	73	74	75	76	*90	91	92	93
	94	95										
LFTLOC	12	70	72	81								
LGRADE	5	8	63	86								
LX	10	*27	48	75	94							
LY	10	*28	46	70	73	92						
M	*30	42	69	97								
N	*41	*44	45	46	47	48	49	55	*68	*71	72	73
	74	75	76	82								
NODEFC	8	12	30	*55	*82	*97						
RGRADE	5	8	36	59								
RGTLOC	12	13	45	46	54							
RIP	5											
RPKERF	13											
RPLOSS	13											

Function DEG



Function RAD